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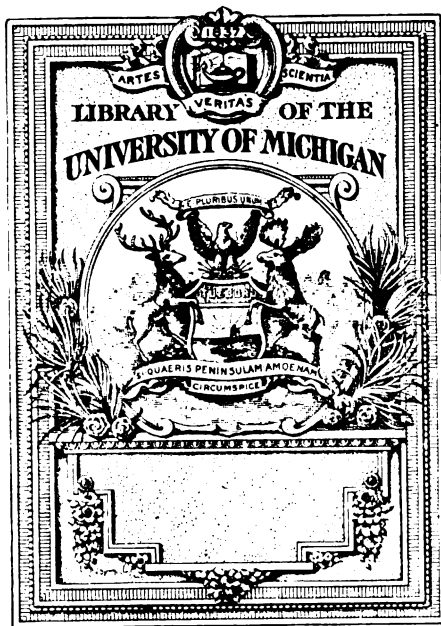
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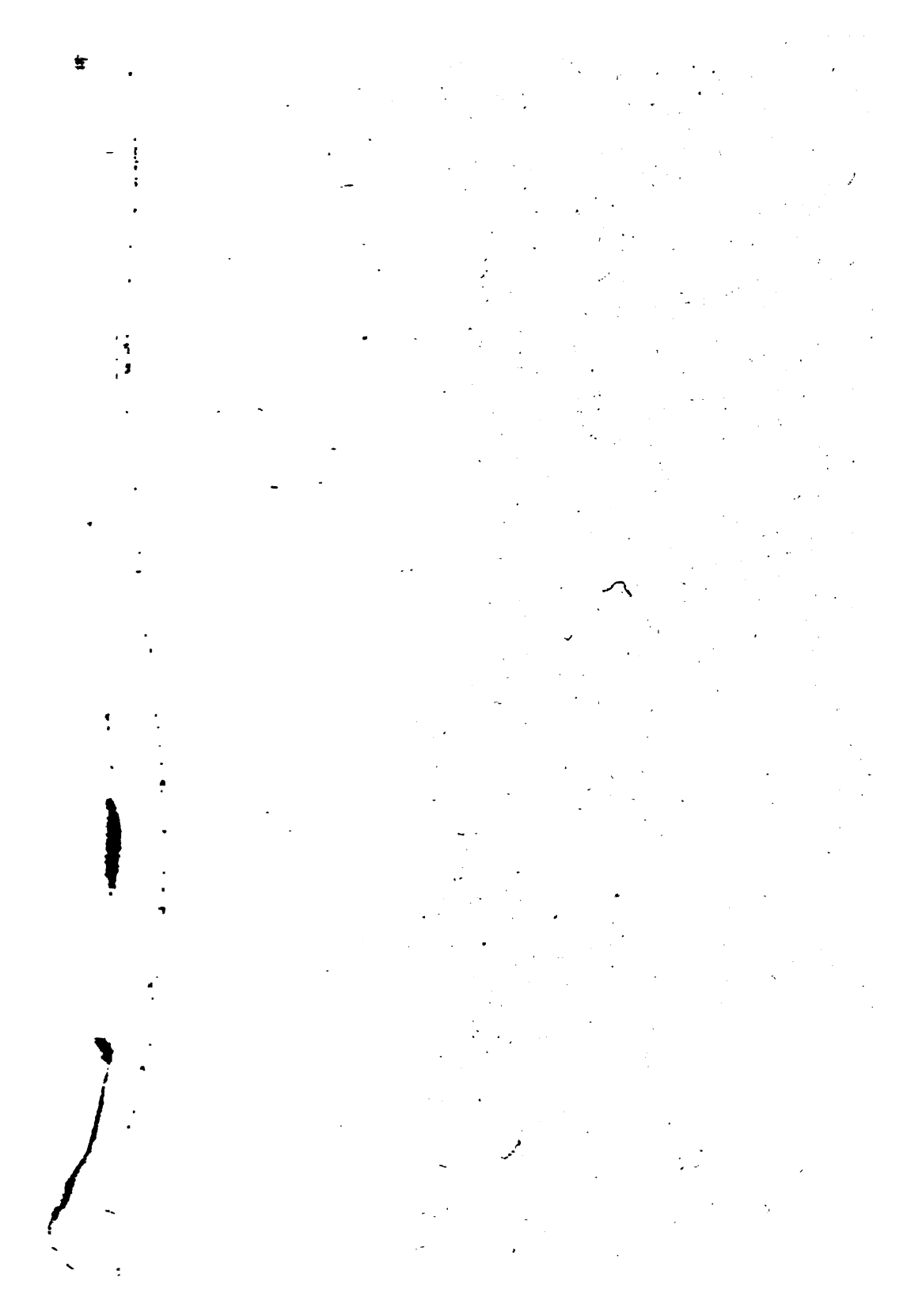
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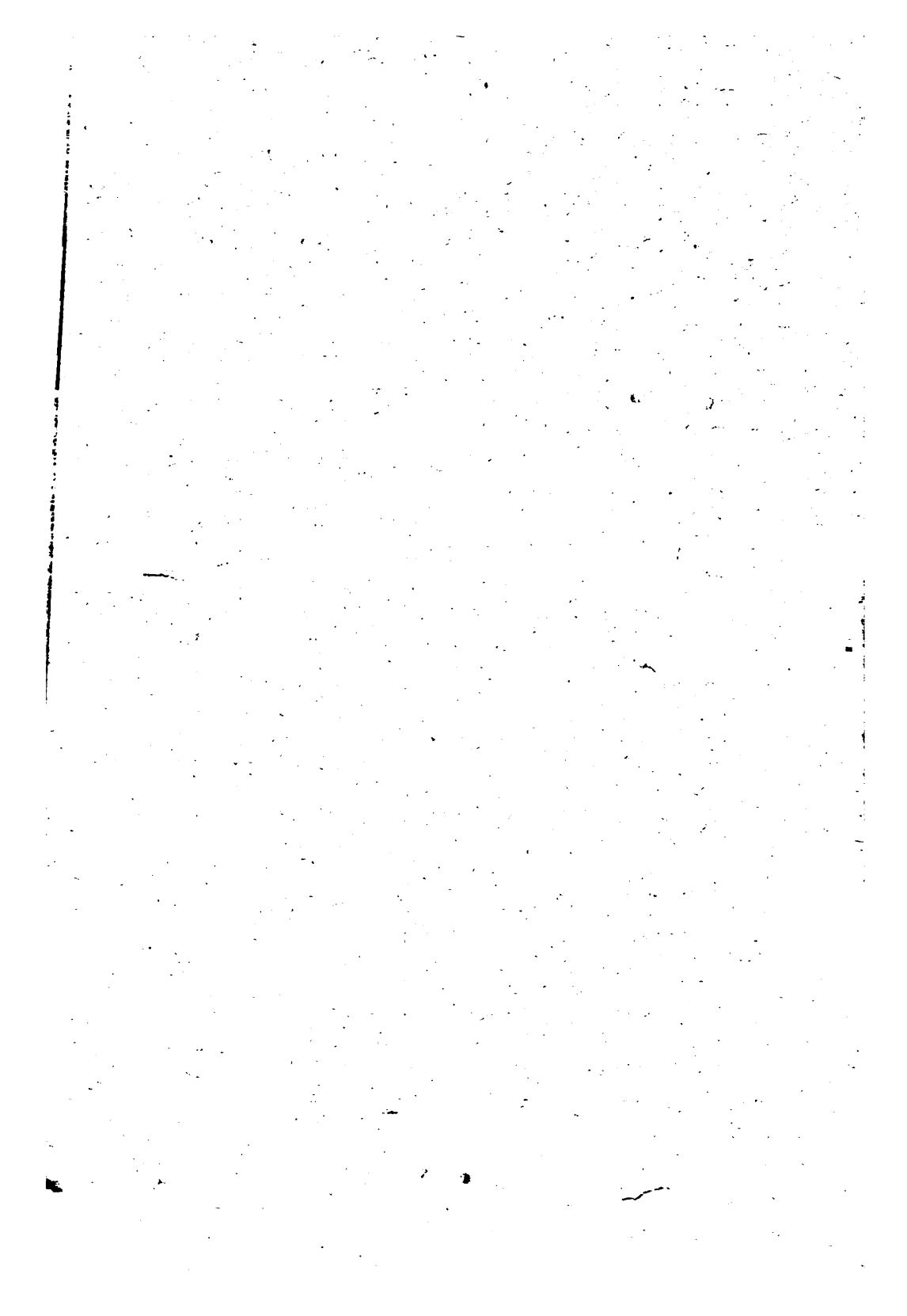
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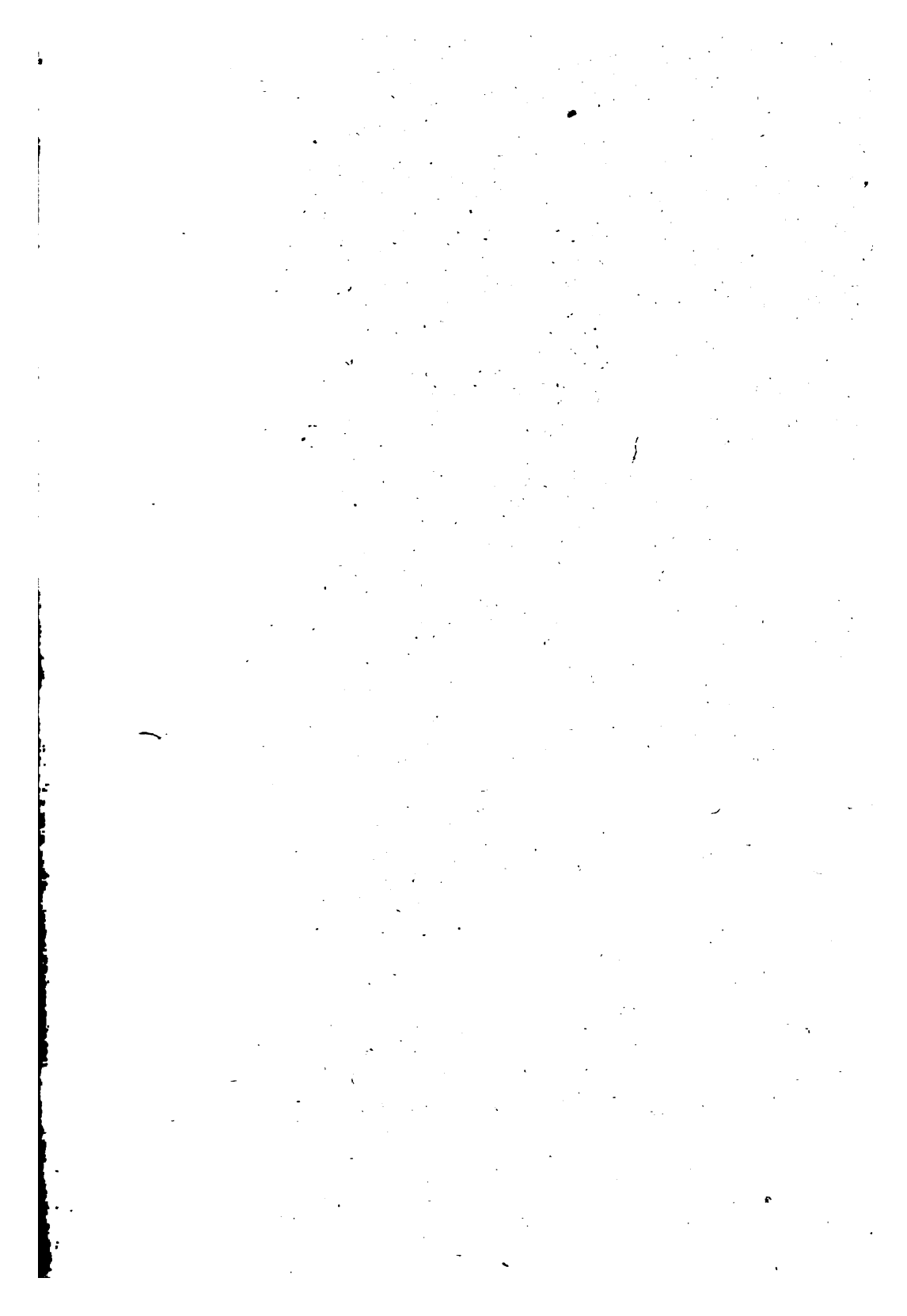
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BULLETIN NO. 61.

JULY, 1902.

FLORIDA
AGRICULTURAL EXPERIMENT STATION.

TWO PEACH SCALES.



By H. A. GOSSARD.

The Bulletins of this Station will be sent free to any address in Florida, upon application to the Director of the Experiment Station, Lake City, Fla.

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1902.

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Two Peach Scales.

Introduction.

Commercial peach growing is certain to become a more important industry in Florida than it is at present; new areas are being planted and abandoned orchards are being reclaimed. Our horticulturists are constantly seeking new varieties, better suited to Florida conditions than those at present grown, and I am confident that they will eventually cease to compete with neighboring states on equal terms but instead will produce distinctive Florida varieties, anticipating all competitors in the early markets and giving northern sections a race for the latest shipments.

Probably the fear of San Jose scale has been a greater deterrent to extensive planting than any other single drawback and the White Peach scale, *Diaspis pentagona*, is not less feared where it is known.

Practices in treating these and similar dangerous scales are not at present what they were a few years ago, and the necessity of reviewing previous recommendations made by the Experiment Station as well as of giving a statement of the most approved of present treatments furnishes the occasion for this bulletin. The conclusions here set forth have not been reached suddenly or unadvisedly, but sufficient time has been taken to observe, to experiment, and to collect the experiences of practical orchardists in the field so as to render the recommendations here made safe, and I am confident that if they are carefully followed results will be satisfactory.

San Jose Scale.

Distribution.

This insect is now so widely scattered over Florida that the problem has become an individual one with every orchardist, and the only aid that the Entomologist can give is to identify specimens and recommend methods of treatment. More than thirty points of infection are known in the state, scattered through about twenty counties, and since I am dependent upon incidental reports and discoveries for my information regarding its distribution, it is safe to say that more unknown cases of infection exist than are upon record.

The nurseries of the state that have my certificate of inspection thoroughly fumigate their stock and if a case of scaly trees having gone out under my certificate has ever occurred I have been unable to discover it, though I have endeavored to ascertain the source of infection in every case of which I have learned. The first certificates issued by me were dated in 1899. A list of the certified nurseries in the state will soon be published in a separate circular. Those who wish to buy only of certified nurseries should demand a copy of the certificate; one firm in the state has used the following expression in advertising its products: "We have an excellent stock of these peach trees that are grown in nurseries free from disease and insect pests. This is certified to by the State Entomologist." This statement, if true at all, is so misleading as to practically amount to an untruth for I have never inspected the stock of this firm and if it has ever had any stock growing in any of the nurseries that were regularly inspected it was not so represented to the inspector. The stock of this firm may be safe enough for anything I know to the contrary, but I warn them and all others that any future use of a similar statement without authority will cause the parties making it to be advertised by name in a way that will

not help their business. The name of this firm is only withheld at present because I know nothing against their stock. I have had some indications that some uncertified nurseries have sold infested stock during the past two or three years, and inquiries addressed to the proprietors asking if they possessed fumigatoriums have elicited no answer. The Entomologist of the Experiment Station is neither a state nor a police officer and has no more power to investigate cases of this kind than any other citizen of this state, but should I find that a nurseryman continues to sell diseased stock without properly fumigating it after being advised that his nursery is infested, I shall not hesitate to publicly expose him, because with our present knowledge of the methods by which dangerous scales on peach stock can be destroyed, there is no excuse for sending out anything but clean stock.

The Native Home of the San Jose Scale.

One of the most important announcements ever made to the fruit growers of the United States is that of the Division of Entomology at Washington, stating that Mr. Marlatt has determined that China is unquestionably the native habitat of the San Jose scale, and that in that country as well as in Japan it is kept in practical subjection by a lady-bug, *Chilocorus similis*, closely related to our well known two-stabbed lady-bug, *Chilocorus bivulnerus*. It is hoped that this lady-bug will find in this country conditions that are as congenial for its multiplication as they are for the development of the scale, and that the end of the long warfare against this most noted pest of all entomological history has been reached at last. The lady-bug feeds upon the white peach scale, *Diaspis pentagona*, and if it proves equal to the task of reducing San Jose and also of preventing the *Diaspis* from repeating San Jose's history, which disaster is not beyond the bounds of possibility, this achievement by the Department at Washington will out-

rank in value any single piece of agricultural work ever accomplished by any similar bureau in the history of the world. However, hopes may be too sanguine and it is possible that many years may yet elapse before we can abandon the methods of warfare which years of experience have developed. A colony of these lady-bugs is promised to Florida whenever the Department is able to distribute them.

Treatment With Crude Petroleum.

During the winter of 1901, some experiments as follows were carried on with crude petroleum at Lake City. The oil used was not tested for specific gravity as the necessity for such a test had not been discovered at that time, but judging from its appearance it must have been very nearly of approved standard composition, 43 to 45 degrees specific gravity.

On the 25th of January some applications of 100 per cent. crude petroleum were given to pear, plum and peach trees. The petroleum was applied with a Deming Kero-water pump with a Vermorel nozzle. The variety of pear was unknown, but three trees, of which I shall speak as No.'s 1, 2 and 3 were badly infested with San Jose scale. Tree No. 1 was apparently nearly dead; the trunk was blistered and crusted with scales, the leaves and branches having been thickly infested the preceeding season clear to the tips; there was probably not an inch in length of living twig to be found in any place upon the tree which was not crusted with scales. To all appearances the tree could not be expected to live whether the scales upon it were killed or not. The bark upon both trunk and branches was very much hide bound and had to be split open with a knife in order to give the new wood a chance to form beneath. This tree was slow in putting out its leaves in the spring, but eventually leaved out and on the first of May seemed to have a fighting chance for life. All

scales upon it were apparently killed. I am uncertain whether it would have been possible for this tree to have recovered any degree of healthful vigor under any circumstances and unfortunately for our observations, it was one of our first pears to succumb to fire-blight. Later two or three sprouts came up from the roots, healthy and free from scale.

Tree No. 2 was a larger pear of the same variety and not so badly infested, although many of the branches were completely crusted and coated with scales and the bark of the trunk and larger branches had to be split with a knife as in the first case to give an opportunity for new growth. This tree leaved out at the usual time and by May 1st was vigorous and thrifty in appearance, apparently not having suffered at all. This tree also perished by fire-blight. I am unable to pass judgment as to whether the petroleum affected the resisting powers of the trees against blight or not. It would be as reasonable to charge any apparent weakness in this respect against the scale as against the spray.

A smaller pear tree, No. 3, was also given a treatment of 100 per cent. petroleum and came through in perfect condition with all scales upon it killed, remaining in health until it was removed by the gardener more than a year after being treated. Fire-blight was unusually severe during the season referred to and many trees died in the same manner as those under observation, though given no insecticidal treatment at all.

Upon the same day a number of plums of eight different varieties, including representatives of the Satsuma, Burbank, Kelsey, Norman, Yellow Japan, Abundance, Bailey and Botan varieties were sprayed with 100 per cent. petroleum. Beside each of these trees in an adjoining row another tree of the same variety was left untreated as a check for comparison. Both the treated row and the check row later showed evidences of unhealthfulness, partly due to crown gall on the roots and partly to obscure causes probably connected with

their location. A much larger number of the sprayed trees died during the next year's interval than of those in the check row, and from the first they were in much worse shape than some adjoining rows that were sprayed with a 30 per cent. mechanical mixture of water and petroleum. Some smaller plum trees which had been in the ground only one year at the time of making the 100 per cent. application seemed to survive without noticeable injury.

One hundred per cent. petroleum was also applied to nine bearing Florida Gem peaches on the 26th of January. Of these trees but two or three ever put forth any signs of life and these quickly died. Two young trees in the same row and of the same variety did not seem injured by the same treatment. Bearing trees of the Florida Gem variety will not stand a heavy dose of crude petroleum in Florida unless the conditions governing its application are different from those that surrounded these particular trees. No special care was taken in making these applications, as my object was to find out what would be the effect of crude petroleum if put on liberally, in quantities sufficient to just reach the dripping point, and without regard to sunshine or the precautions that are generally observed in making applications of kerosene.

Some hundreds of plum and peach trees of several varieties were sprayed with from 15 to 30 per cent. mechanical mixture of petroleum and water during the first three weeks of February and I was unable to detect the least injury of any kind following any of these diluted applications, the trees remaining under observation for two years after the treatment was given. The trees in all cases were sprayed until they reached the dripping point and in no case were they banked, nor was any attention given to cloudy weather nor to the hours of evening near to dusk. Some applications were made upon bright days but most of the time the weather was decidedly hazy, the sun being scarcely if at all visible.

The experiences of others that the oil would remain on

the trees for some weeks and that it can be plainly seen just what parts of the trees have been treated, and that the oil will gradually spread a considerable distance from the spot where the liquid has fallen I was able to confirm throughout. As I also made some applications of kerosene, 15 to 20 per cent. at the same time, I decided that the petroleum seemed to be the more desirable insecticide, although it might not come through the pump quite so easily as the kerosene mixture.

Very careful comparisons of the sprayed and unsprayed trees were made to ascertain the effect of the application on the bloom with the result that I was unable to discover any injury where the diluted spray was used. The buds were swelling at the time the applications were made, many of them being just ready to burst. At this time, when the currents of life are beginning to flow and assimilative processes are commencing in the outside leaves of the buds and when the vital organs of the blossom are not pressed in close contact to the sheathing parts of the perianth, conditions are most favorable for giving treatment without endangering the crop.

Some of the trees were sprayed when a strong wind was blowing and on such trees the work was not thorough, the scale again developing after a few months, but where the conditions of application were reasonably suitable complete extermination seemed to be the result with the weakest material used. A few months later, natural agents, especially "San Jose Scale fungus" *Sphaerostilbe coccophila*, which Prof. Rolfs had introduced into the orchard about two years previously developed to such a degree that no further spraying was necessary, and indeed no conclusions could have been reached as to the efficacy of such treatment after this time.

My horse was blanketed as a protection against injury from the spray falling upon him.

Experiences of Practical Orchardists.

The following record from the journal of Mr. Wm. Macklin, of Dinsmore, Duval county, Fla., is printed with his permission and is commended to the attention of all peach growers because of the evident care with which the treatment was given and the close observations he made.

November 23, 1900.

After my return from England, after a four months absence, my foreman called my attention to a very bad attack of San Jose scale that had developed in my peach orchard during the time I was away. On careful inspection, I found that almost all the trees were affected, some so badly as to be incrustated with the scale and in a few cases killed; the others, though not coated with scale, were all infected more or less. As I could hear of no treatment that promised such success, I decided to try kerosene or crude petroleum, spraying with a Gould's "Kerowater" spray pump, but did not commence the treatment until January, since I was informed that it was better to let the buds become slightly swollen as they would then be in the best possible condition to withstand the effect of the oil which might possibly do some injury. Bulletin 146, New Jersey Experiment Station, advised the use of crude petroleum only when of a specific gravity of 43 degrees or over, and as the Standard Oil agency in Jacksonville could not at the time give me any information about the crude oil they had in stock I began by spraying with kerosene.

January 14, 15 and 16:

Sprayed with kerosene, 25 per cent. per gauge on pump, but according to actual measurement of the kerosene and water, when allowed to settle after being sprayed into a graduating glass, the mixture showed only 20 per cent. oil. This strength was adhered to throughout.

January 16: Examined trees sprayed 14th and 15th. Some of the scales appeared dead but many still alive. Kero-

sene on trees sprayed 14th beginning to dry off. Weather 14, 15 and 16 warm with bright sun.

January 17, 9.00 A. M.: Raining since 8.30 A. M. Examined trees again. Kerosene quite apparent as the rain stands unevenly on the tree in globules. This effect least marked on trees sprayed 14th. Examined scale; some undoubtedly dead but a large proportion still alive showing bright yellow when pierced with the blade of a knife. When squeezing the scale as above, noticed instances where a thin film of oil ran out from beneath the scale. A few open blooms on the Jewel variety show damage to the edges of petals from the oil; look as if they had been touched by a slight frost. Cannot detect any damage to the interior of the bloom.

January 18: Cut off two twigs from trees sprayed 14th and dipped them in water; greasy state of the trees very apparent as the water would not lie on them. Can find plenty of dead scales but also plenty of live ones. Painted two trees with pure kerosene applied with a brush. Tree No. 1, three years old, Waldo, so badly crusted with scale that bark of main limbs is completely hidden. Painted thoroughly almost the entire tree except very smallest twigs. Tree had been sprayed with twenty-five per cent kerosene on 14th. Tree No. 2, Jewel, two years old; trunk crusted with scale so as to hide bark, larger limbs nearly encrusted but not so as to completely cover the bark. Tree still fairly vigorous and healthy. Painted trunk and main limbs with pure kerosene. Tree had been sprayed with 24 per cent mixture of oil and water on 15th.

January 19: Sent twigs showing orange colored fungus growth to State Entomologist to determine whether it was the fungous disease of the scale. Reply received, saying that it was the disease referred to (*Sphaerostilbe coccophila*).

January 20: Continued spraying with crude petroleum same strength. Having been informed by Standard Oil company at Jacksonville that the crude oil in stock was between

43 and 44 degrees specific gravity abandoned kerosene altogether. Examined trees sprayed 14th and 15th, noticed many more dead scales. The perfectly healthy scales found were very few. Effect of treatment more encouraging. Examined trees painted with pure kerosene on 18th. Encrusted parts still contain living scale. Scale on other parts all dead.

January 21 and 22: Continued spraying with crude oil.

January 27: Examined trees sprayed 14th and 15th; did not find a living scale.

January 28: Finished spraying.

February 14: Scales apparently all dead. Trees sprayed with crude petroleum still quite greasy. No greasy effect noticeable on those sprayed with kerosene.

March 2: Trees sprayed with crude oil still greasy, scales all dead.

April 10: Sprayed trees healthy, and no bad results from the oil treatment, no live scale apparent anywhere. Painted tree No. 1 dead but death more probably due to scale than to painting with undiluted kerosene. Tree No. 2 alive and fairly healthy. As far as can be judged at this date a weaker spray than 25 per cent. would be sufficient to destroy the scale.

August 1: No further notes were taken. At present the trees are healthy and have made a better growth than last year. Remarkable recoveries were made by many trees which were so badly injured by the scale as to make their death seem almost certain.

Unfortunately, a one year old grove in which we did not notice any scale at the time of spraying was left untreated and I now find some scale there, and in a very few instances an isolated specimen or two in the sprayed groves, but the destruction of the scale was as complete as possibly could be expected and I am of the opinion that had we sprayed the young grove alluded to that it would have been practically eradicated. The crude petroleum used was a brown oil and

the much greater lasting greasy effect made it infinitely superior to the kerosene. The Gould Kerowater pump has one important defect. The oil tank which is imbedded in the water barrel is not sufficiently watertight at the top, the result being that in hauling to the orchard the water splashes over the top of the tank, displacing a certain amount of oil which in turn goes into the water barrel. In this way oil is lost and in starting to pump, all the water which has passed over into the tank and sunk to the bottom of the oil has to be pumped out before a mixture will be obtained. Otherwise the pump suits the work well enough.

The treatment has been a marked success, tho owing to the fact that one grove was not sprayed it left a breeding place for the scale. I will repeat it this winter, when I believe we will completely eradicate it. In the case of diseased limbs where the bark was unsound the oil penetrated the bark and destroyed the limb. This was the only injurious result noticed and there was no oil penetration on sound bark. The trees bloomed and fruited naturally, though much of the crop on the earlier varieties was cut off by frost. The later kinds bore a heavy crop.

Some of the trees were sprayed just before the rain came on (but none while it was actually raining) and it did not seem to make any difference in the destructive effect of the oil on the scale. Great care was taken to cover the trees thoroughly with the spray without applying so much as to have the mixture running down the tree to any great extent. The oil destroys rubber hose very quickly and after a couple of weeks use the hose is useless. The horse used for hauling the pump should be covered with water proof cover as otherwise he gets wet by the spray which blisters the skin and temporarily removes the hair.

Under date of March 2, 1902, Mr. Macklin writes: "I may now add to my letter (the one just given) that after two year's experience with the crude oil treatment, I consider the

San Jose scale the least to be dreaded and the easiest to control of any parasite or disease affecting deciduous trees that we have hereabouts. No orchard need be seriously injured by the scale if the above treatment is used. Though I have sprayed thousands of trees I have never seen one suffer the slightest injury from the oil if sprayed while dormant."

Another correspondent writes: "I have had but one year's thorough experience with crude petroleum on peach trees, and even from this experience am unable to give exact results, except that we apparently killed every San Jose scale and incidentally some of the trees.

I made two applications of crude petroleum to my peach orchard the past winter. A few of the trees had considerable San Jose, but very few of them were affected in this way to an extent sufficient to weaken their vitality. The vitality of nearly the whole orchard had, however, been very seriously affected by too much water around the roots. The ground upon which the orchard was located did not drain off well and the excessive rains that we had here during the past eighteen months had nearly killed some of the trees and weakened others. The trees had been already weakened and could not stand the double dose of petroleum and quite a number of them succumbed. I do not think, however, that any of the trees that were in first class condition were very seriously affected by the double dose of petroleum.

From my rather imperfect data I should recommend but a single application of crude petroleum and this, according to my experience, should be made after the buds are well swollen or are just breaking out—of course a little ahead of the bloom. Contrary to my expectations the trees on which the buds were well swollen came out better than those on which the buds had not yet commenced to swell.

The application was made with a Deming bucket pump and I think the nozzle was a Bordeaux. I am not sure of this, however, as we have several different kinds of nozzles. I have

just purchased a Gould's Kerowater barrel pump, the hose of which is fitted with Vermorel nozzle. I have not, however, had occasion to use it yet.

The percentage of crude petroleum used was twenty-five, water seventy-five.

I am inclined to believe that for peaches one or more applications of 15 per cent. kerosene made after fruit has been picked in the summer—and always on sunny days—is really less harmful to the tree than crude petroleum, unless the petroleum is applied at just the right stage of bud expansion—and this is hard to regulate through an orchard of mixed varieties." From another correspondent we quote: "Our spraying with kerosene or crude petroleum in winter has only been with pear trees. We have used varying strengths from 10 to 50 per cent. We made two applications to most of the trees. Those that were sprayed with from 20 to 50 per cent. showed the petroleum as long as two years on the trees, making them a dark chocolate color. We did not think any of the trees were injured by the mixture. The little summer spraying we did on peaches was with 15 per cent. of kerosene oil, in Deming kerosene sprayer. It killed whatever scales there were on the trees and did no damage whatever to the foliage or trees. We never knew what kind of scale was on the peach trees."

Mr. W. H. Bliss, of Chipley, Fla., wished to use his Knap-sack pump without going to the expense of purchasing a Kerowater machine and was advised to make an emulsion as follows: Dissolve one-half pound of whale oil soap in one gallon of water and while still hot pour in two gallons of crude petroleum, away from the fire, and after testing a small quantity of the oil in the heated water to make sure that the point of ignition has not been passed, then pump the mixture back into itself until a thick creamy mass is obtained. For use dilute one gallon of the emulsion with nine gallons of water.

Under date of June 22, 1902, Mr. Bliss writes: "Yours of

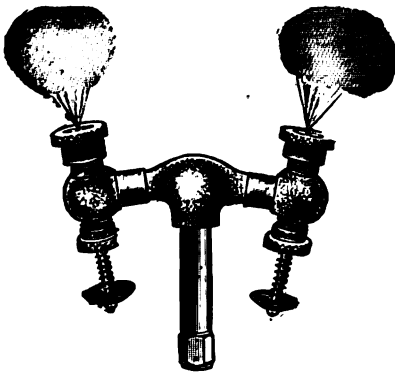
June 14th duly received and would have been answered sooner but I wanted to inspect a few trees that were very scaly this spring, before answering your letter. I have looked them over carefully and am very glad to say that I cannot find a single live scale on any of them. I also requested one of my men to see if he could find any; he says he has not been able to find one. I sprayed twice and if I find any scale this fall I think I shall spray in December and January with the same mixture. There is no doubt in my mind that this is the right mixture with which to exterminate the scale. Before I used this mixture I cut out a number of trees that were full of scale and which I am now satisfied I might have saved."

Crude petroleum can be ordered from the Standard Oil company, Jacksonville, Fla. In ordering be explicit in the statement that the oil is wanted for insecticidal purposes and that it must be from 43 to 45 degrees specific gravity. The present quotation on such oil is 14 cents per gallon f. o. b. cars, Jacksonville.

Summer Treatment.

Where correct winter treatment has been employed no summer treatment will be needed. Crude petroleum will not do for summer use nor can it be applied to evergreen plants, as the heavy oils choke the breathing pores of the leaves causing them to fall. Ten or fifteen per cent mechanical mixture of kerosene and water applied only on bright, sunny days and when there is not too much humidity in the air at the time the young scales are hatching and migrating will be satisfactory. Whale oil soap, one pound in four gallons of water also timed to catch the young scales is practiced by many with good results. Good's Potash Whale Oil Soap, No. 3 or Leggett's Whale Oil Soap compound are well adapted to such use.

PLATE I.



Gould's Double Vermorel Nozzle.



Deming Vermorel Nozzle, (single.)



Gould's Kero-water Sprayer.

11074

At 70U

Pumps and Nozzles.

The best pumps upon the market and adapted to throwing crude petroleum and kerosene mixtures so far as they have been tried in Florida are the Kerowater sprayers made by the Gould Manufacturing Company, Seneca Falls, N. Y., or by the Deming Company, Salem, Ohio. The Spramotor pump, made by the Spramotor Company, London, Ontario is said to be fully equal to the very best machines yet produced but it has not yet been tried in Florida so far as I have learned. The Vermorel nozzles are better adapted to Kerowater use than any others known to me. The cut of Kerowater machine was furnished by the Gould company, the cut of single nozzle by the Deming company.

***Sphaerostilbe Coccophila* or Disease of San Jose Scale.**

In August, 1897, Prof. P. H. Rolfs, then Biologist of this Experiment Station, now in charge of the U.S. Semi-tropical Laboratory at Miami, Florida, announced the discovery of this fungus growing indigenously upon San Jose and other scales in Florida. Prof. Rolfs instituted some interesting experiments to test the practicability of fighting the scale in orchards with this fungus and I quote as follows from his records (Bulletin 41, Florida Experiment Station). The experiments given were located in the orchard of Mr. John Astleford, of DeFuniak Springs:

"Experiment No. 1.—A plum tree sprayed twice with spores of this fungus prepared by placing some of the infected bread in a quart of water. The first application was in the afternoon and the second just before dark, July 29, 1896. A portion of the tree was then wrapped with a moist gunny sack.

"Result.—February 20, 1897. Scales thoroughly inoculated. The disease having spread to many branches.

"Remark.—The idea of wrapping moistened burlap or other cloth loosely about the treated limbs is well worth following out. It is a question of only a few hours whether the spores are to produce the disease or whether they will die. If a moist atmosphere prevails all is well and good, if drouth, the spores will die. The reason for this is brought out strongly in the study of the biology of this fungus, so it will not be stated here.

"Experiment No. 2.—A peach tree in good condition, except severely infested with San Jose Scale, which seemed perfectly healthy, was sprinkled late in the afternoon of July 29, 1896 with material similar to that used in experiment No. 1.

"Result.—February 20, 1897. Insects not affected. No trace of disease.

Experiment No. 3.—A peach tree like the one in experiment No. 2, sprinkled July 29, 1896, with material similar to that used in experiment No. 1.

"Result.—February 27, 1897. Insects all dead.

"Experiment No. 4.—A peach tree like the one in Experiment No. 2, sprinkled, July 29, 1896, with material similar to that used in Experiment No. 1.

"Result.—February 27, 1897. Insects not affected. No trace of disease.

"Experiment No. 5.—A peach tree a considerable distance from No. 2, but conditions very similar to the one in Experiment No. 2, sprinkled later in the evening, July 29, 1896, with material similar to that used in Experiment No. 1.

"Result.—February 20, 1897. A large proportion of the insects dead and peeling off. The disease well disseminated throughout the tree."

An examination of Mr. Astleford's orchard at the present time discloses a most interesting monument of Prof. Rolf's discovery. It consists of about forty acres of peach

U. S. N. A.



View in Mr. Astleford's Orchard.—“This orchard is carrying a good crop of fruit.”



Peach Orchard Destroyed by San Jose Scale.— The fungus was not established in this orchard, neither was any treatment given.

Mr. U

trees, now about twelve years old or reaching well up toward the extreme natural limit of life of a Florida peach orchard and has had San Jose scale in it for six or seven years. Before the introduction of the fungus it was sprayed repeatedly with resin wash but with only temporary relief. Since the introduction of the *Sphaerostilbe* no insecticidal treatment of any kind has been given to this orchard. Every tree has been scaly at one time or another, yet but few trees are missing, perhaps not more than would be wanting if the scale had never visited it, and but little scale can now be found. It occasionally becomes conspicuous on some trees or on certain limbs, but disappears as if by magic whenever a brief rainy season enables the fungus to thrive.

This orchard is carrying a good crop of fruit this year, and has done so for several years. Except when damaged by storms, a fair estimate places the yield per tree at about one bushel, nearly half of which is rendered worthless by the curculio.

In striking contrast with Mr. Astleford's orchard another of 80 acres is shown in Plate III, not over one-fourth of a mile distant, the two orchards having become infested at about the same time. The fungus was established in the dead orchard too late to be of service and the abandoned buildings and packing houses on the premises complete the scene of desolation, emphasizing as nothing else could the value of applied scientific knowledge as made known by the Experiment Station.

In 1898 Prof. Rolfs planted in an enclosure at Lake City twenty-five or thirty trees of peach, plum and Keiffer pear with branches interlocking, and infected a few (I think two of them) with San Jose scale, at the same time introducing the fungus. When I first saw the two originally infected trees, at the beginning of 1899, the trunks had died back to the base, but clean, healthy limbs had sprung out below the point of death and were making a strong, vigorous growth.

A few of the adjacent trees were just beginning to show the scale. During the summer the insects spread to nearly all the peach and plum trees in the plot, passing the pears, and threatened to destroy them the second season. However, spreading more slowly but just as certainly as the scale was the fungus and a minute lady-bug—a species of *Scymnus*, the two together finally striking a balance with the scale, which has since been successfully maintained, and I have no doubt the trees will remain in first class condition indefinitely without any need of treatment. During warm, rainy weather the fungus easily outstrips the scale. Observations upon an orchard of several hundred trees, also at Lake City, were commenced at about the same time. How long it had been infested when I first saw it, I cannot say, but most of the pears were so nearly dead by 1900 that they were all dug up and destroyed. Adjoining the pears were several hundred peach and plum trees just beginning to show signs of the scale in particular areas. With the exception of a single treatment with varying strengths of crude petroleum and kerosene already referred to, these trees were allowed to take their own course. A very few died outright, but their death might be charged to several other causes as readily as to the scale. The limbs of some trees died, undoubtedly from scale attack, and everything suffered, but a balance was finally reached which was practically maintained until the entire orchard was destroyed to make room for other crops better suited to the land upon which it was set. Prof. Rolfs had established the fungus at several different points in the orchard in 1898 and this was doubtless the chief natural agent checking the increase of the scale, though it was assisted by the minute lady-bug previously mentioned. Mr. Astleford reports that his trees at DeFuniak became black with these lady-bugs previous to his introduction of the fungus but they did not perceptibly decrease the scale.

Mr. Astleford's method of "planting" the fungus is to tie a

piece of cardboard against a scaly spot upon a tree so as to form a "wall pocket." Infected scales, scraped from diseased patches of scale or scaly twigs upon which the fungus is established are dropped into the bottom of the pocket and a wad of wet cotton or of damp sphagnum moss is then put in the top. Within twenty-four hours the disease will generally have established itself. The fungus is usually found without difficulty on the "obscure" scale, infesting nearly every live oak tree in the state. It is most conspicuous just after a rain, appearing as small orange-red tufts from beneath and among the scales.

Fungous Treatment Combined With Fumigation.

Spraying with kerosene, petroleum, whale oil soap, resin wash and similar preparations destroys fungous growths as well as scales, but fumigation with hydrocyanic acid gas, while deadly to insect life, does little or no injury to fungi or plant life and is therefore the proper auxiliary treatment to employ where the main reliance is upon *Sphaerostilbe coccophila*. By introducing and disseminating the fungus and fumigating during the winter season such trees as have not been reached or cleaned by the disease, an orchard can in all probability be kept in satisfactory shape at a minimum of expense. The box tents used in Maryland or the hexagonal tents used by Prof. Sirrine in New York are the best patterns for work with peaches. Descriptions of these tents can be found in Prof. Johnson's Fumigation Methods published by the Orange Judd Co., New York.

White Peach Scale.

(*Diaspis pentagona*.)

Distribution.

Besides San Jose scale this is the most dangerous peach enemy in Florida, equalling San Jose in destructiveness where it has become established. Fortunately it has never obtained a foothold in any large nursery in the United States and our present system of nursery inspection with the likelihood that its natural enemy, the Chinese lady-bug will follow it up from its incipency, renders it unlikely that it will ever become so generally scattered as San Jose. The original home of this scale seems to be China or Japan as Mr. Marlatt's recent explorations revealed it sparsely scattered over much of the territory of both countries, its numbers being limited by the lady-bug, *Chilocorus similis*, previously mentioned as feeding upon San Jose scale, and indicating that it is indigenous to those countries. Recently some peach wood collected by the U. S. Department of Agriculture in China and mailed to one of our Florida fruit growers for propagation was sent to me for examination and proved to be slightly infested with this scale. It also occurs in Ceylon, Australia, Fiji, Jamaica, Trinidad, Martinique, Grand Cayman, Barbados, San Domingo, Grenada, and Antigua. In the United States, outside of Florida, it is found in the District of Columbia, in California, in Ohio and in Georgia. Prof. Scott reports that it has utterly destroyed some large orchards in Georgia, one of 10,000 trees located at Irby.

In Florida it was first observed at Quintette in 1889, by Mr. S. F. Harvey whose postoffice at that time was Molino. The original source of infection seems to have been trees brought from California or from a nursery then existing in

Thomasville, Georgia. The present territory infested around Quintette is comprised in a radius of about three miles and includes perhaps not more than a dozen orchards. The old Harvey orchard was long ago killed by the insect. In January, 1901, Mr. Geo. Veloudois, of Nesbitt, Duval county reported this scale as destroying his peach orchard. He had first noticed the insect about two years earlier on the limb of a large mulberry tree, suggesting that it had been introduced by birds, but from what place the bird could have come is very problematical.

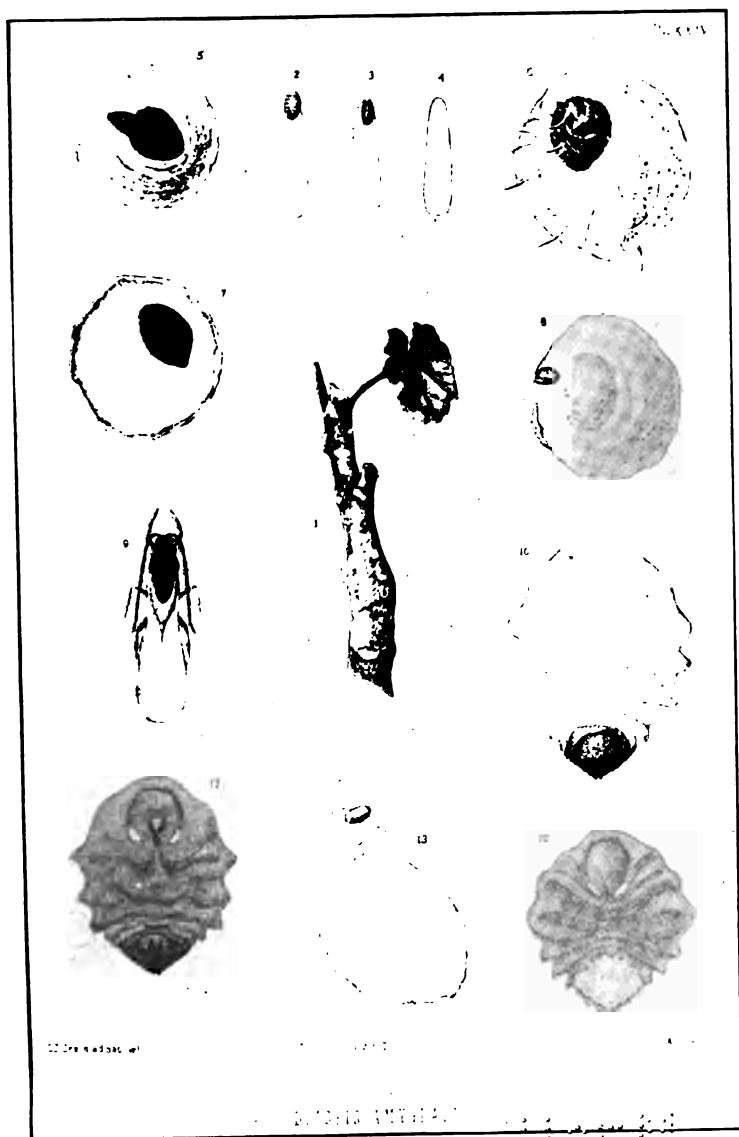
Food Plants.

The list of known food plants is lengthy but important for Florida since the scale is evidently a very polyphagous feeder on tropical and semi-tropical plants. It attacks the peach, mulberry, plum, apricot, cherry, pear, grape, persimmon, *Guajuma ulmifolia* (Bastard cedar), *Cycas media*, *Cycas circinalis*, *Capsicum* (pepper), *Argyreia speciosa*, *Bryophillum calycinum*, *Pelargonium*, *Jasminum*, *Zizyphus*, *Tylophora asthmatica*, heliotrope, stems of cotton, *Calotropis procera* (French Cotton), *Hibiscus esculentus* (okra), *Carica papaya* (melon pawpaw), *Acanthus*, *Sedum*, *Zamia mexicana*, *Callacarpa lanata*, *Ricinus communis* (Palma Christi or castor-oil plant), and some unnamed garden plants. Leconte and Keiffer pears are not attacked by it in Florida nor does it seem to thrive on weeds and garden plants in this state, part of which are named in the above list.

Explanation of Plate IV.*Diaspis Pentagona.*

- Fig. 1. Piece of geranium stem with colony of insects.
Fig. 2. Male puparium, from above, uncarinated form.
Fig. 3. Male puparium, from above, with median carina.
Fig. 4. Male puparium from below.
Fig. 5. Female puparium, upper side, from smooth part of stem.
Fig. 6. Female puparium, upper side, from hairy part of stem.
Fig. 7. Female puparium from below.
Fig. 8. Female puparium, from above, with pellicles concealed.
Fig. 9. Adult male, dorsal view.
Fig. 10. Adult female, dorsal view.
Fig. 11. Adult female, ventral view, before oviposition.
Fig. 12. Adult female, ventral view, after oviposition.
Fig. 13. Female puparium, from *Tylophora* (Chionaspiform variety). (Photographed from E. Ernest Green's Coccidae of Ceylon, by H. H. Hume.)

PLATE IV.



800

Description.

The female scale is 2 to 2.5 mm. or .08 to .10 inches in diameter, quite convex and usually grayish white in color. The scales are often inconspicuous from being covered with a thin layer of the skin of the outer bark. Again they stand out conspicuously white against the natural color of the plant they infest, naked, glossy and smooth. Where they rest upon a hairy surface, the hairs are elevated and united with the surface texture of the scale, standing erect in their original position. Scale irregularly circular, and in the younger specimens oblong. Exuvia orange yellow, inclining to brown or reddish-brown in lines and spots, sometimes approximately central, again approaching the margin. Ventral scale very thin, whitish, remaining adherent to the plant. Removing the dorsal scale exposes the female insect, usually of a bright orange color, but again varying from pale creamy white to rosy pink according to the food plant. The posterior extremity or anal plate is always brownish. Shape broadly oval, widest and rounded in front, narrowing to two closely approximated serrated or scalloped points behind. Segments of abdomen very distinct.

The male scale is pure white, exuvia pale straw color. Uncarinated or median keel feebly developed. Length 1 to 1.5 mm. or .04 to .06 inches. The male scales cluster together in dense chaffy patches, preferably on the lower parts of the branches of young trees, and on the trunk near the ground giving the impression of a coat of whitewash at a distance from the tree. A scattering male scale can generally be found here and there among the females. The adult male is a minute, two-winged insect, bright red in color, with darker head and pale legs.

Life History.

At Washington there are three broods per year, egg-laying commencing the first week in May and hatching of the spring brood occurring about a week later. The scales reach maturity during June, oviposition for the second brood beginning during the last week in June. The winged males issue from one to two weeks before egg-laying begins. By the middle of August the second brood has matured, the eggs of this brood being laid near to the end of the month. A third brood develops at the end of October.

Prof. Scott states that in Georgia there are three or four broods, the first appearing about the middle of March if the season is favorable. Mr. G. F. Mills, a correspondent at Quintette, Florida, writes that there are four broods per year in his section and he believes there are sometimes five. Prof. Sasaka of the Tokio Agricultural College states that in Japan the insect breeds only twice per year.

Treatment.

Professor Scott of Georgia recommends that about the same winter treatment be given for this insect as for San Jose scale. Twenty per cent. mixture of kerosene and water or whale-oil soap at the rate of one pound in one gallon of water is specifically approved. For spring treatment he recommends that ten per cent. mixture of kerosene or whale-oil soap, one pound to four gallons of water, be applied while the young of the first brood are migrating which is usually during the latter part of March. Prof. Scott has observed that February freezes greatly reduce the scale in numbers. Mr. H. Maxwell Lefroy, Entomologist of the Imperial Department of Agriculture for the West Indies recommends resin wash, several times repeated at intervals of about a week.

The California State Board of Horticulture gets more

satisfactory results from fumigation under tents than by other means.

Mr. J. A. Anderson, of Quintette, obtained quite satisfactory results by spraying with machine oil, one of the by-products of crude petroleum, being unable to procure the latter material. For winter spraying crude petroleum used as for San Jose scale is recommended.

Natural Enemies.

The two-stabbed lady-bug, *Chilocorus bivulnerus*, feeds upon this scale and when carefully encouraged is apparently able to subdue it. The lady-bug larvae may sometimes be counted by dozens upon single limbs, and trees that are plastered with the scale are often cleaned up perfectly in a few weeks. Mr. Anderson reports that an orange red fungus attacked the insect on some trees two years ago, but has not since been observed. The description suggests *Sphaerostilbe coccophila*.

Summary of Important Facts.

1. Florida is well able to compete with other states of the South in growing peaches for the market.
2. Two among the most important insect enemies of the peach tree are San Jose scale and the White Peach scale.
3. Crude petroleum of 43 to 45 degrees specific gravity applied in 20 per cent. mechanical mixture with water is an efficient winter remedy for both of the above named scales.
4. The trees should be banked with earth about the roots to catch the surplus spray and the application should be made on a bright sunny day. The spray-soaked earth about the roots should be removed within a half hour after the work is completed.
5. A Kerowater machine with Vermorel nozzles should

be used or if an ordinary pump is employed an emulsion must be prepared.

6. Blanket the horse attached to the spraying wagon.

7. One thorough application while the buds are swelling or ready to burst is sufficient and is recommended.

8. The pump should be tested periodically by allowing the spray to settle in a graduated vessel to learn if actual percentage of oil being used tallies with the setting of the gauge.

9. The surface of the tree should be thoroughly covered with spray but there should be but little running of the liquid down the trunk to collect at the roots.

10. Trees in leaf in spring and summer should be sprayed with a 10 to 15 per cent mixture of refined kerosene and water when the young are migrating; or instead of kerosene use whale oil soap, one pound of soap to four gallons of water.

11. The fungus, *Sphaerostilbe coccophila*, has proven itself a practical success in some orchards through several years of trial. It is a cheap and seemingly reliable remedy if used in conjunction with tent fumigation.

12. The fungus should be collected from the live oak scale or other known source of supply and planted in a cardboard "wall pocket" against a scaly tree, the top of the pocket being filled with moistened cotton or sphagnum moss. The fungus must be established soon after the scale for securing satisfactory results.

13. Peach trees should not be fumigated except during the winter season.

14. The two-stabbed lady-bug is a very efficient enemy of the White Peach scale and when well established is able to subdue it without help.

BULLETIN NO. 62.

JULY 1902

FLORIDA
AGRICULTURAL EXPERIMENT STATION.

THE
PEEN-TO PEACH GROUP



By H. HAROLD HUME.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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1902.

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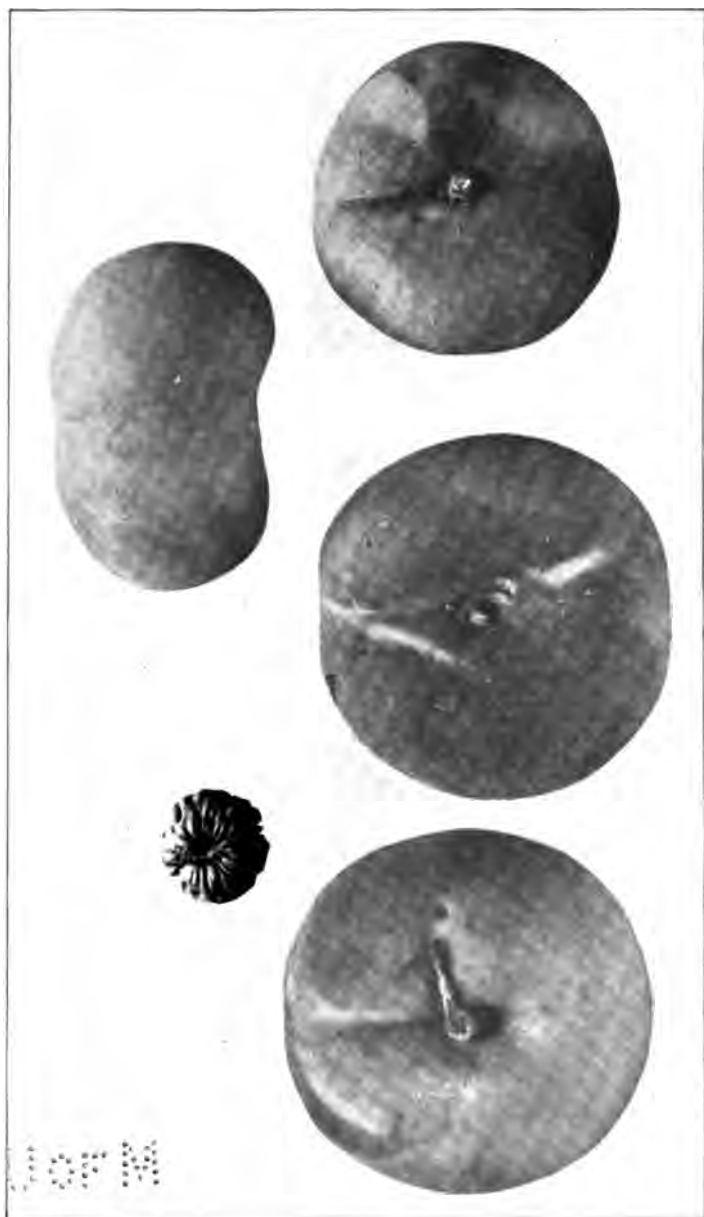
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1875

PLATE I.



The Peen-to,(reduced) "Introduced into the South in 1869."

The Peen-to Peach Group.

Introduction.

Peach culture, as an industry in Florida, has now assumed very considerable proportions, despite the many obstacles which have had to be overcome. When attempts were made in this state to grow the varieties adapted to and planted in the great peach growing districts of the more northerly states, failure was almost always the result. Much effort was wasted in the vain attempt to compel varieties totally unsuited to our exacting conditions, to grow where they would not.

That the peach industry has reached its present status is largely due to two things, the untiring efforts of a few men interested in the work, among whom must be mentioned G. L. Taber of Glen St. Mary and T. K. Godbey of Waldo and to the introduction of the Peen-to and Honey* varieties. These with those of the Spanish* race, selected seedlings from varieties introduced by the Spaniards long ago, constitute fully two-thirds of the varieties listed by our nurserymen and the orchards of the state show a far greater preponderance of varieties of these groups.

The Peen-to group of peaches is essentially adapted to sub-tropical conditions and they are peculiarly Florida peaches. With the exception of the parent and progenitor, the Peen-to, every member of the group has originated in the state, and Florida must be credited with giving to the world an interesting and exceedingly valuable group of fruits.

The group is limited in its adaptations to the state of

*Considerable work has been done on these groups, which will constitute a second publication on peach growing in the state

Florida, coast regions of Texas, Louisiana, Mississippi and Alabama, in brief to Pomological District six and the extreme southern portion of District five as defined in the Catalogue of Fruits of the American Pomological Society, Bulletin 8, Division Pomology, U. S. Department of Agriculture.

But even within the above defined area the adaptation of the different varieties is to a very large extent a local matter. While some varieties of peaches succeed over a very large area and under what appear to be widely different conditions, on the other hand, as is the case with the varieties of the group under consideration, many peaches are adapted to very restricted areas. The recommendations as given in the latter part of the bulletin are based upon results obtained by the orchardists of the state.

A few years ago, the author would have hesitated greatly before publishing anything in regard to peaches on account of the destruction wrought by the San Jose scale. But that insect is no longer considered as a menacing factor in peach growing. The excellent results obtained through the various means of control as outlined in Bulletin 61 of the Florida Station by H. A. Gossard have changed the whole phase of the question. We are now in a position to say that Florida can control the early peach market and can compete successfully with other states in the sale of late varieties.

The Peen-to Peach in England.

The Flat Peach of China, evidently a peach of the Peen-to group and with which the name Peen-to was considered synonymous by Downing was introduced into England sometime early in the 19th century. What was believed to be the first fruit produced in England was grown by Mr. John Braddick and exhibited before the London Horticultural So-

ciety¹ in 1820, under the name Java peach. The tree came from Mr. Kirke, a nurseryman, who secured the variety from Java. The variety is also referred to by Lindley² and Knight³.

History of the Peen-to Group in America.

The first peach of the Peen-to group was introduced into this country by William Prince of Flushing, New York, proprietor of the Linnean Botanic Garden and the author of several important works on Horticulture. The introduction was made sometime previous to 1829 for in his "Treatise on Horticulture" published in that year, he says: "About twenty trees are in possession of the author, which have been inoculated from the original introduced by himself." It is highly probable that Prince secured his original tree from England.

Downing refers to the Peen-to peach but his description is not true for that variety as we know it. He had probably never seen the fruit and certainly he had no trees in his possession at the time of the publication of the second edition of his "Fruits and Fruit Trees of America," 1885. In the foot note at the bottom of page 638, he says: "Should any one of our amateurs now possess it, we shall be much gratified to receive buds of it." A foot note conveying the same sense is found on page 500 of the first edition, 1850.

All traces of the first introduction by Prince are lost and it is to P. J. Berckmans, of Augusta, Ga., that we owe this

1. Trans. London Hort. Soc., Vol. IV, 512-513, Pl. XIX., 1822.

2. Trans. London Hort. Soc., Vol. V, 549, 1824.

3. Trans. London Hort. Soc., Vol. V, 271-273, 1824. A letter from Knight to the Secretary, received. Jan. 7, 1823.

valuable group of peaches in the South. In 1869 Mr. Berckmans secured seed from Australia and from this seed, a peach was grown which was called Peen-to. While succeeding in South Florida this Peen-to peach was not a success in North Florida for, though growing luxuriantly, a crop of fruit could not always be depended upon because of its early blooming habit. But from the parent variety has sprung a number of seedlings well adapted to the different parts of the state.

Characteristics of the Group.

The trees are vigorous, upright in habit, prolific, and well covered with foliage. After fruiting for a number of years the heads become more open and spreading. The leaves are long narrow, pointed, finely serrated and with reniform glands at the base. The flowers are large and pink and are produced in great abundance. The fruit, with the exception of that produced by the Peen-to and one or two others, is roundish in outline, occasionally blunt pointed. The flavor of those varieties which more closely resemble the parent Peen-to have a decidedly or slightly noyau flavor. In other varieties this flavor is entirely lacking and it may be acid, sub-acid or sweet. The skin is easily removed and the stone may be either free or cling. For the most part they are well colored and of good appearance. The ripening period of the varieties of this group (known at present) extends from April to the middle of July or a little later though by far the greater number of varieties mature their fruit by July 1.

Varieties.

About twenty-two or three varieties of Peen-to peaches have been catalogued by Florida nurserymen. The cata-



Fig. I.—Angel—"Tree, open-headed and a heavy bearer.



Fig. II.—A young Yum Yum orchard at Hampton, Fla.

Moll

logues for the winter of 1902 listed about fifteen varieties. The catalogue of the Florida State Horticultural Society gives ten varieties. Many of the varieties at first listed by nurserymen have given place to better varieties and many of them have entirely disappeared from cultivation.

The description of the Peen-to variety the progenitor of the whole group, is given first, after which the varieties are arranged alphabetically.

The past season has been one of extreme drought throughout the whole State of Florida. In consequence the peaches have been undersized and due allowance will have to be made in the measurements, because of this fact.

PEEN-TO (*Berckman's cat.* 1873 and 1877).

Flat or very decidedly oblate; medium to large, in size 1-1 13x16 or 1x2, frequently reaching three inches in diameter; cavity broad, shallow, reddish or green; stem short, stout; suture narrow, short, extending about half way to the apex; apex depressed, depression broad and rather shallow, suture side extending below the level of the apex; skin velvety, tough, rather thin, easily removed, bitter; color yellowish green, washed with red on exposed parts; flesh yellowish white, firm, but melting and juicy; stone cling, rather deeply pitted and furrowed, small, flat, 3-8x11-16; quality very good; flavor sweet, sometimes decidedly noyau; season May 15 to June 1.

The tree is rather upright in habit with slender branches, leaves long, narrow, pointed and finely serrated.

Described from specimens received from W. E. Embry of Dade City, Fla. The Peen-to peach is adapted only to South Florida unless protection can be given it.

Introduced into the South in 1869 by P. J. Berckmans, Augusta, Ga.

ANGEL. (*Taber's cat.* 1891-92).

Rounded; size medium or large, 2x1 5-16x1 7-8; cavity

rather broad, shallow open, stem short, stout; suture short, shallow extending from cavity to periphery about 3-4, remainder indistinct; apex blunt, rounded or very slightly tipped; skin very fuzzy before ripening, smooth and velvety afterwards, thick, not bitter; color a light creamy tint washed with red on exposed parts; flesh firm, white, juicy, stone free, pitted, short, oval, brown, medium sized, 1 1-8x1 3-16x5-8; quality excellent; flavor agreeable, slightly acid; season June 15 to July 4.

Tree open headed and a heavy bearer, requires thinning, a good shipper.

Described from specimens gathered in the orchards of J. Allen, Hampton, Fla. and of Thomas Williams, Waldo, Fla. and from specimens forwarded by William Macklin, Dinsmore, Fla. The specimens on account of the extreme drought were undersized.

The Angel peach was grown from seed of Peen-to by Peter C. Minnich of Waldo, Fla. The original tree was secured by G. L. Taber of Glen St. Mary, Fla., and by him propagated and distributed.

BARR'S EARLY. (*Taber's cat.* 1892-93.

Barr's Early Daisy. (*Taber's cat. sup.*, 1888-89).

This variety appears to have disappeared from cultivation. The following description is copied from Taber's catalogue 1891-92: "Seedling of Peen-to; resembles Bidwell's Early in shape; size medium to large; showy in appearance; sub-cling. Quality excellent and claimed to be a prolific bearer. Matures one week later than Peen-to."

Originated by Col. John Barr of Micanopy, Fla.

BARR'S LATE. (*Taber's cat. sup.* 1890, listed).

Barr's Late Daisy. (*Taber's cat.* 1891-92).

Described in Taber's catalogue for 1891-92 as follows: "Seedling of Peen-to; resembles Barr's Early, but matures two weeks later. Quality excellent." This variety has dis-

appeared from nurserymen's catalogues and is no longer planted in commercial orchards.

Originated by Col. John Barr, of Micanopy, Fla.

BIDWELL'S EARLY. (*Taber's cat.* 1887-88).

Roundish oblong, size medium to large, 2 3-8x2 1-8x2 1-16, 2 1-8x2 1-4x2 1-8; cavity abrupt, open, rather wide, of medium depth; stem short; suture inconspicuous in some specimens, in others extending about half way along the side, shallow; apex rounded with a small recurved point; skin velvety; color creamy white colored deeply red on exposed parts; flesh firm, medium white, juicy; stone cling, thick, oval, medium size, 1x3-4x5-8; quality very good; flavor sweet, agreeable with slight noyau flavor; season May 20 to June 15.

Described from specimens received from Walter Cooper of Sorrento, Fla.

Originated by the late A. I. Bidwell at Arlington, Fla. from seed planted about 1882.

BIDWELL'S LATE. (*Taber's cat.* 1890-91).

Round or roundish oblong; size large; color yellowish white; flesh meaty, juicy; stone cling; quality excellent; season June 15 to July 1.

Originated by the late A. I. Bidwell at Arlington, Fla.

CLARA.

Oblong rounded, large, 2 1-8 in diameter; cavity rather deep, abrupt, of medium width; stem short, stout; suture almost entirely lacking, represented by a slight depression about a half inch long; apex rounded, oblique with very small tip; skin velvety, easily removed; color yellowish, quite red on exposed parts; flesh firm, white, melting slightly tinged with red beneath colored parts on skin, juicy; stone free, large, oval, pointed, 1 3-16x3-4x5-8; quality very good; flavor sweet slightly noyau.

Described from specimens received from C. C. Shooter, Earleton, Fla.

An early peach of fair quality originated by T. K. Godbey of Waldo, first fruited in 1900. A seedling of the Waldo peach.

DOROTHY N. (*Taber's cat.* 1901).

Specimens of this variety have not been seen. The following notes are taken from the catalogue referred to above. Nearly round; size large; flesh yellow; stone free; flavor rich, sub-acid; quality fine; season July 5-15.

Originated by G. H. Norton of Eustis, Fla.

EARLY ARLINGTON. (*Taber's cat. sup.* 1890-91).

In the place referred to above this variety is simply priced and the author has not been able to obtain a description of it.

FLAT PEACH OF CHINA.* *Prince Treat. Hort.* 16-17 1829. (*Downing, Fruits and Fruit Trees of America.* 500. 1850.)

Chinese Peach, (*Cat. Fruits Lon. Hort. Soc.* 96. 1831.)

Java Peach, (*Trans. Lon. Hort. Soc.* 512-513. 1822.)

Peen To, (*Cat. Fruits Lon. Hort. Soc.* 96. 1831.)

A very singular variety from China, where the gardeners affect all manner of vegetable curiosities. The fruit is of small size, about two inches in diameter, and so much flattened at the ends that only the skin and the flat stone remains, the fleshy part being crowded on either side. The tree is of rather dwarfish habit, and holds its leaves very late. The fruit is of very good flavor and is well worth a place in the gardens of the curious.

Leaves with reniform glands. Fruit small, so much flattened as to form a deep hollow at both ends, having at the top a singular broad, rough, five-angled eye. Skin pale yellowish green, mottled with red on one side. Flesh pale yellow.

*The references given are the earliest in American literature. For English reference see *Trans. Lon. Hort Soc.* 512-513, 1822.

low with a circle of red round the stone (from which it separates), sweet, juicy, with a slight noyau flavor. Beginning of September. Flowers large. (Description copied from Downing, see reference above.)

The variety described by Prince, Downing and others under the above name and with which the name "Peen-to" was considered by Downing and others as synonymous is not the Peen-to peach as we know it in this state. Since the variety known in Florida and adjoining states under the name Peen-to originated from seed, this is not to be wondered at.

In strict adherence to the rules of Horticultural nomenclature, our Peen-to peach should not be so called. The name however has become firmly established, the "Peen-to" of Downing and English writers is unknown to us as a variety except through their writings. Hence the name Peen-to for our variety may be allowed to stand in American Pomological literature.

A close reading of the descriptions given above and on page 509 will convince anyone that the conclusions regarding the identity of these varieties is correct. The frontispiece is from a photograph of a cut used by Downing in an article on "New and Singular Chinese Peaches" in *The Horticulturist*, Feb., 1847, page 382-384.

FLORIDA'S OWN. (*Taber's cat. sup.* 1888-89).

This variety is no longer cultivated but in the supplement referred to above it was described as follows: "Seedling of the Peen-to, size large, shape nearly round, appearance handsome, skin white overspread with carmine. Flesh sweet, juicy, rich and melting. Sub-cling. Quality excellent. Claimed to be as early as the Peen-to and very prolific; the original not having missed a crop in four years. A few peaches of this variety that have been shipped North have

brought exceedingly fancy prices and received pronounced endorsements from consignees."

HALL.

Hall's Yellow.

Oblate rounded or somewhat oblong; size large 2 5-16x2 3-6x2 5-16; cavity broad, open, and shallow; stem short, stout; suture shallow or almost lacking, 3-4 inch long, narrow; apex rounded; fruit bulged at one side near the apex; skin quite fuzzy before maturity, when matured velvety; not bitter; color chrome yellow washed with red on exposed parts; flesh meaty, firm, not very juicy, yellow, red about the stone with radiating lines for about 1-4 inch; stone free, large, brown, oval, pointed, thick, 1 3-16x7-8x3-4; quality excellent; flavor pleasantly acid very agreeable; season June 15 to July 1.

Described from specimens received from E. H. Hayward, DeLand, Fla. This variety is a good free stone peach in many respects resembling the Elberta. It was originated by R. C. Hall of Volusia county, and is certainly worthy of attention.

JEWEL. (*Taber's cat.* 1895-96).

Roundish oblong; medium to large, 2 3-16x2x1 15-16, 2 1-8x1 3-4x1 3-4; cavity of medium width, abrupt, open, rather deep; stem short, stout; suture frequently lacking, if present short, narrow, and deep; apex blunt pointed, point abrupt, short, and recurved; skin velvety, not bitter, easily removed; color creamy washed with red on exposed parts; flesh whitish slightly red about the stone, juicy; stone free, reddish, oval, one inch long; quality excellent; flavor sweet, agreeable of good character; season May 20 to June 1. A good market variety. Though earlier than Waldo it is quite reliable even in North Florida.

Described from specimens received from Walter Coop-

er, Sorrento, Fla., C. C. Shooter, Earleton and Wm. Macklin, Dinsmore, Fla.

The Jewel peach is a seedling of the Waldo and was originated by T. K. Godbey of Waldo, Fla. It was first fruited about 1894 or '95. The variety was selected as being the best in an orchard of 500 Waldo seedlings. It blooms before and with the Waldo but ripens its fruit about two weeks earlier.

JUNE BEAUTY. (*Taber's cat. sup.* 1888-89).

In Taber's catalogue sup. for the season of 1888-89 this description is given: "Seedling of the Peen-to. Follows Maggie in maturity. Sub-cling; shape roundish oblong. Size medium to large."

Originated by Peter C. Minnich of Waldo, Fla.

KITE.

Oblong, large, 2 1-4x2 1-16x2 3-16, 2 3-8x2 3-16x2 1-8; cavity large rather abrupt, medium depth; stem short; suture wide, short, of medium depth, extending one-half or three-quarters inch along the side; apex rounded with a very short tip situated in a very shallow depression; skin velvety, quite fuzzy before ripening, thick and easily removed; color creamy washed with red on exposed parts; flesh firm, melting, creamy, slightly pink around the pit, juicy; stone cling. 1x3-4x9-16; quality medium, rather lacking in character; flavor sweet, lacking in acidity, no trace of noyau; season first two weeks in June.

Described from specimens received from C. C. Shooter, Earleton, Fla.

This variety was originated by Robert Kite of Waldo and was first fruited in 1885. In speaking of it Mr. Godbey said that it was the first Peen-to seedling of natural peach shape that he had ever seen.

LAURA. (*Taber's cat. sup.* 1890-91).

Specimens of this variety could not be secured. It is

mentioned in Taber's price list, season 1890-91 and described in the catalogue for 1891-92 as follows: "Seedling of the Peen-to, originated in this county, where it has borne heavy crops for several years. Size very large; almost exactly round; flesh white, sweet, juicy, and of fine flavor; cling stone. Quality excellent. Ripens nearly with the Peen-to."

MAGGIE. (*Taber's cat. sup.* 1888-89).

Roundish oblong, size medium to large; cavity open, abrupt and rather deep; stem short; suture extending about one fourth of distance along the side to apex, at the upper end continuous with the cavity gradually sloping off; apex rounded, small point set in a very shallow depression; skin velvety, thick; color very light yellow or yellowish white washed with red on exposed parts; flesh firm, white, melting and juicy, stone partly cling, brown, oval, large, 1 1/4 x 7/8 x 5/8; quality very good indeed; flavor sweet, pleasant, of good character; season May 20 to June 10.

Described from specimens received from Walter Cooper, Sorrento, Fla. A very good early peach ripening with Bidwell's Early and Yum Yum, the former of which it closely resembles.

Originated by Peter C. Minnich of Waldo, Fla.

MASCOTTE. (*Griffing Bros.' cat.* 1898).

Specimens of this variety have not been received. The following notes have been taken from the catalogue referred to above. Size large, 2 1/2 to 2 3/4 inches in diameter, nearly round with small point; color creamy yellow washed or flecked with carmine shading to deep red on exposed side; flesh creamy white, red about the stone, juicy; flavor sub-acid rich; stone free; season a few days later than Waldo.

Raised from seed of Waldo by Griffing Bros. Co. First fruited when two years old in 1894.

ORLANDO. (*Taber's cat. sup.* 1890-91).

The variety is listed but no description is given.

11-11-11

PLATE II.



"The Waldo is one of the best Varieties for North Florida."

QUEEN OF THE SOUTH. (*Taber's cat. sup.* 1890-91, listed, *Taber's cat.* 1891-92.)

This variety has been replaced by better ones. It is described thus in the catalogue referred to above: "Seedling of Peen-to. Size large; nearly round; flesh sweet and of good flavor, cling stone. Ripens a week later than the Peen-to.

RIVAL.

Rounded oblong, rather flattened at both base and apex, size large, 2 1-8x2 5-8x2 3-8, 2 1-8x2 1-4x 2 5-16; cavity very broad, shallow, sloping gradually; stem very short, stout; suture almost entirely lacking, represented by a slight, broad, shallow depression extending for about one-half inch down the side; apex flat with a very slight depression; skin velvety, free from bitterness, thin, easily removed; color quite yellow (chrome) washed with dull red on exposed parts; flesh yellow, red about the stone, firm and juicy; stone free, brown, oval, thick, pitted and abruptly pointed, 1 5-16x1 3-16 x1 1-16; flavor sweet with slight acid, agreeable; season July.

Described from specimens received from E. H. Hayward, DeLand, Fla., July 16, 1902. The leaves are large, long, narrow, pointed and finely serrated.

SUBER. (*Taber's cat.* 1896-97).

Oblong rather rounded; large, 2 1-8x2x2, 2x2 1-8x2; cavity rather narrow, abrupt and deep; stem short; suture narrow, shallow, extending about one-third the distance along the side; apex rounded; skin velvety, leathery, separating easily; color creamy yellow flushed with pink on exposed parts; flesh whitish, firm, meaty; stone cling; quality excellent; flavor sweet, slightly noyau, good character.

Described from specimens received June 13, 1902 from J. P. Mace, Lake Helen, Fla.

The Suber peach was originated by a colored man of the

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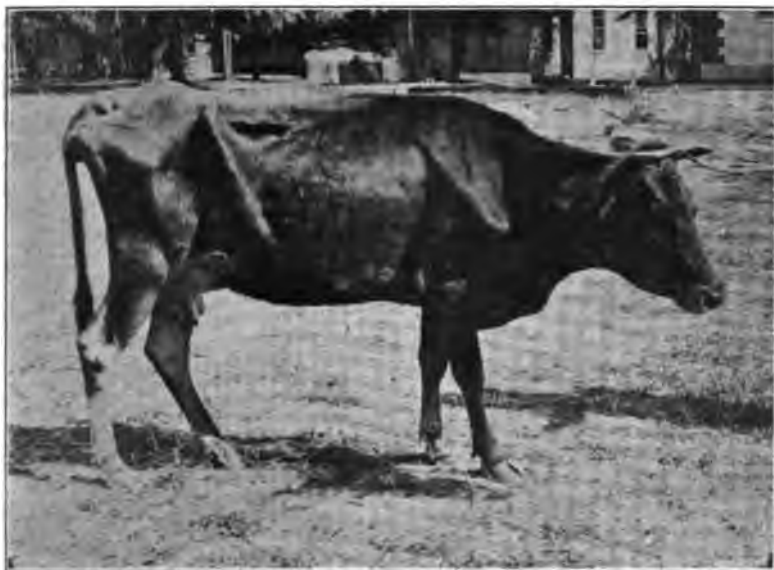
BULLETIN NO. 64.

OCTOBER, 1902.

**FLORIDA
AGRICULTURAL EXPERIMENT STATION.**

(DEPARTMENT OF VETERINARY SCIENCE.)

Texas Cattle Fever and Salt-Sick.



(Photo. by Prof. H. H. Hume.)

A Victim of Chronic Texas Fever.

By DR. CHARLES F. DAWSON.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

DeLand, Fla.:
E. O. PAINTER & COMPANY,
1902.



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*Supt. Farmer's Institutes.

Texas Cattle Fever,

With Remarks Upon the So-Called Salt Sick.

SYNONYMS.

Texas Fever is known by a great variety of names, among which may be mentioned, Southern cattle fever, Tick fever, Spanish fever, Splenic apoplexy, Red-water, Hæmaturia, Distemper, Bloody murrain, Pasture poisoning, Acclimation fever, Town cow disease, Hollow-tail, Hollow-horn.

The disease is called Texas fever in this bulletin because it is the one now generally adopted by all writers upon the subject and not because it should be called by that name by reason of its having originated in Texas.

. *Geographical Distribution.*—Texas fever has a very wide geographical distribution. It is not only found in much of that portion of the United States known as the South and Southwest, but disease of a similar nature in cattle has been reported from the West Indies, South Africa, Australia, the Danube basin in Europe, Roumania, South Russia, South America, Central America and Mexico.

.. *Animals affected.*—So far as is known, Texas fever is found affecting only the bovine species, it being most fatal to adults. Calves under a year old generally do not take the disease in a fatal form, although every susceptible bovine when subjected to the infection contracts the disease, and frequently in a fatal form, if an adult, and in a mild form if under six months of age.

The Cause.—This remained for a long time a mystery. Over a hundred years ago, an outbreak of disease occurred in

Pennsylvania native cattle shortly after a herd of cattle from South Carolina had been driven through the state. These cattle themselves were apparently in perfect health, yet it was shown that they scattered the contagion along their trail. Similar outbreaks have occurred in times past, and in some of them the losses have been enormous. We thus see that the disease is recorded to be a century old in America even, and it is highly probable that it is as old as the cattle industry itself in the temperate and tropic zones. It is now definitely known that Texas fever is a blood-disease, and the infective principle is carried from one bovine to another by the cattle tick, whose scientific name is *Boophilus annulatus*. It is equally well known that the cattle tick produces the disease by inoculating cattle with a germ which it harbors in some part of its own body. This germ is so small that it requires a high-power microscope to detect it in the blood of the sick animal. After it has entered the body through the bitten areas it penetrates the red corpuscles of the blood and destroys them, thus producing a train of symptoms indicative of the disease.

Symptoms.—Texas fever occurs in two forms, the *acute* and the *chronic*. In the acute form the symptoms are about as follows: A fever which may be as high as 108 degrees F. occurs in the animals several days before they are known to be sick. During the first two or three days the temperature will be highest in the evening; then the morning temperature will gradually rise and the fever remain permanent for seven or eight days, when the animal either dies or recovery begins. In either case, the fall of the temperature to normal, or even below normal, is as sudden as was the onset. The respirations are increased from twenty, the normal, to sixty or seventy, and the pulse from sixty to one hundred per minute. There is complete loss of appetite,

and emaciation is very rapid, even continuing after the fever has ceased. In severe cases, and in most cases that will terminate fatally, the urine is wine-colored, or blackish from the blood coloring-matter it contains; a condition which has given the disease the names, red-water, black-water and hæmaturia. While the fever is on, the bowels are usually constipated; but when the fever subsides, a diarrhoea may set in, the feces being of a yellow color. During the height of the fever there is loss of vision, some delirium and staggering gait. Finally the animal becomes so weak that it is unable to rise when down. The blood becomes quite thin and pale in color. In some of these acute cases the animal becomes almost wild and persons describe them as being blind and crazy. In a recent outbreak in native range cattle in Alachua county, the animals exhibited symptoms of intense itching behind the ears, and wild delirium. One poor animal constantly rubbed against the end of a sharp fence rail until it penetrated the hide and was forced into the tissues of the neck for a distance of several inches, producing an infected wound whose swollen and bloody condition reminded one of a case of black-leg, a western cattle disease. Relapses frequently occur, but are milder in character than the initial attack.

In the *chronic* form of the disease all the symptoms described as occurring in acute attacks are milder in character and are prolonged. The temperature rarely rises above 105 degrees F. in the evening while in the morning it is about normal. Red-water is not present as a symptom. The blood disease continues but is less rapid in its effects. In fact, the chronic form of the disease could hardly be diagnosed during life, without the aid of a microscope, and not even then in some cases. It is not always fatal, and the animal makes a slow recovery after being out of condition for a month or two.

POST-MORTEM APPEARANCES IN THE ACUTE FORM.

If an animal which has died in the acute form of the disease be cut open and examined, the following gross appearances will be noted: On cutting through the skin there may exude through the incision small gas bubbles and yellowish liquid.

The skin frequently presents no important alterations. The region of the dew-lap, the udder and escutcheon show the effects of the tick-bites. Passing the hand over these regions, one feels the little elevations, and sometimes the hair is matted together by the blood or serum which has escaped from the bites. Sometimes the fat is yellowish from jaundice. The meat is of a mahogany color, and emits a disagreeable odor.

The Mouth.—Sometimes the alterations here consist of dark-red spots or patches in the substance of the tongue. Frequently there is nothing abnormal in this situation.

The Rumen, or paunch, or first stomach is sometimes discolored. The epithelial lining will peel off in cases where the animal has been dead some hours; but the condition is not always present, and has little diagnostic value, although it is made much of by some persons.

The Reticulum, or second stomach usually presents no marked alterations.

The Omasum, third stomach, the book or manyplies, seems to attract the most attention from the lay observer. It is frequently described as being full of dry food, and shedding its lining; while in reality it is more often natural in appearance.

Sometimes it is slightly reddened and sheds its lining when the animal has been dead for some hours. In some cases the contents are somewhat hard and dry, or they may be soft. Upon

the whole the appearances here have no bearing upon the cause of death.

The Abomasum, fourth or true stomach, is always congested, and frequently ulcers of the mucous membrane, especially at the outlet, or pylorus, are to be found.

The Intestines.—These are also congested and present about the same appearances, except the ulcers, as the fourth stomach. However, portions of the mucous membrane may be passed with the dung, or a catarrhal discharge may occur from the bowels.

The Lungs show no changes except hypostatic congestion, or a reddened condition of the lungs due to the gravitation of the blood to the side upon which the animal is lying.

The Heart will, upon close examination, present very important changes. It will be noted that the small blood vessels upon its surface are much enlarged and congested, and that here and there small areas of reddened tissue appear. Upon cutting open the heart these reddened patches are more easily seen on the inside membrane. They are practically hemorrhages due to the inability of the small arteries to keep the blood within their walls. The heart muscle itself is pale and easily torn, and the interior of the heart contains clotted blood. The right side of the organ is distended and filled with a solid blood clot, while the left side is contracted and contains only a small amount of clotted blood. The blood vessels leading from the heart are usually filled with blood clots from which the blood corpuscles have been removed; they are of a yellow color and may be removed as long cylinders.

The Liver.—This organ is always affected. It is enlarged. Its margins are rounded, and its tissue is very easily torn with the fingers. Upon cutting through it, one discovers that its

ducts are stagnant with bile and large quantities of dark, stagnant blood escape from the cut blood vessels. The gall-bladder is usually filled with thick, ropy bile.

The Spleen.—This organ is also much affected. It is very noticeably enlarged, and if cut into, a dark, tarry substance escapes; or if it is held up by one end, the contents gravitate to the lower end in time.

Departures from the normal condition in the abdominal cavity are of frequent occurrence, such as dropsical conditions in the region of the liver, kidneys and small intestine.

The Omentum, caul, or fat on the stomach, very frequently shows little fleshy growths which consist of small arteries distended with blood. In some cases these growths are quite prominent, and are the subject of special remark upon the part of bystanders.

The Kidneys.—These organs are generally much congested, dark in color, and enlarged. Their substance is easily broken with the fingers. There is frequently considerable discoloration of the tissue surrounding these organs. Upon section, blood will ooze from the cut surfaces.

The Bladder usually contains urine of a high color, sometimes that of wine; or, it may be as dark as coffee. I have frequently noticed little or no deviation from the normal color. Generally albumen may be detected, and always in the high-colored urine. The specific gravity may be as high as 1040, with strong alkaline reaction. Later in the course of the disease it may fall to 1020, is slightly alkaline or even acid in reaction.

MICROSCOPIC POST-MORTEM EXAMINATION.

If slices of the heart, spleen, liver and kidneys be cut so

thin that they are transparent and are otherwise properly prepared for microscopic examination, very important changes in these organs will be noticed. Sections so prepared from the heart muscle show the minute blood vessels or capillaries densely packed or engorged with red blood corpuscles. The individual muscle cells making up the heart muscle will, in many instances, show that their protoplasmic substance has changed to fat; in other words the heart has undergone fatty degeneration.

Microscopic examination of sections of the spleen show that the great increase in size of the organ is due to the enormous increase in the blood-corpuscle content, and coloring matter from the blood.

Sections of the liver show that this organ has also undergone fatty degeneration of the cells making it up, and that the bile channels which surround the cells are clogged with bile which gives each hepatic cell the appearance of having a golden border. In addition, here and there a hepatic cell has in its substance irregular clumps of bile or blood pigment.

If similar sections of the kidneys are examined, the blood vessels are engorged with red corpuscles and a considerable amount of pigment is to be seen scattered here and there, with occasional fatty degeneration of the epithelial lining of the uriniferous tubules.

While the changes in the liver, spleen, heart-muscle and kidneys are of a serious nature, they are only secondary to those which have taken place in the blood, which tissue is the primary seat of the disease. A microscopic examination of the blood will show an enormous decrease in numbers of the red blood corpuscles; a decline from about 5,000,000, the normal number, to as low, in some cases, as 1,500,000 per cubic milli-

meter. The corpuscles will also exhibit great changes in size and shape, appearing shriveled and crenated. If a drop of the blood of an animal suffering with the fever be prepared for examination, in the fresh state, by means of a microscope of five hundred to one thousand amplification, one notes, in addition to the shriveled and crenated condition of the corpuscles the presence, here and there, of bright bodies inside the red corpuscles. In some cases it is impossible to detect these bodies in the blood obtained from the skin of the animal during life. In others a small percentage of the corpuscles will contain them, sometimes only two or three per cent. Although we find that the peripheral blood during life may contain so few of the affected corpuscles that none may be found after a careful search through several blood preparations, quite a different condition of affairs will be found if, after death, some of the blood of the liver, kidney, heart-muscle or the fleshy growths previously noted as occurring on the caul or omentum be subjected to microscopic examination. In such specimens the infected corpuscles may reach as high as fifty per cent. These bodies are the cause of the disease. They are inoculated into the animal by the cattle tick. They then enter the corpuscles and destroy them at the rate of about a million per cubic millimeter per day. It is the effort of the kidneys to rid the blood of the *debris* resulting from this enormous destruction which causes the urine, in many acute cases, to become bloody. Where the destruction is slow, as in a few acute cases, and in all chronic cases, we do not find the urine so noticeably affected. If the blood preparation be made from the live animal suffering with the fever, the intracorpuseular bodies mentioned above will be pear-shaped or pyriform and will occur in pairs, or there will be two, in most cases, in each corpuscle. If the preparation be

made an hour before death these pyriform bodies will be seen to be nucleated or to contain a round, more opaque spot. If these blood examinations be deferred for some time after death the intracorpuseular bodies will be found to have changed their size and shape. They are now much smaller and round, not pear-shaped. This change in size and shape from the large pyriform to the small round form would seem to indicate that the round form is the inactive or resting stage in the life-history of the parasite.

The parasite of Texas fever was discovered by Professor Theobald Smith in 1889, and was named by him *Pyrosoma bigeminum*. It is to Smith's splendid work upon Texas fever, given to the scientific world through the medium of a government report* that we owe most of our present knowledge of this disease. His investigation has also thrown much light upon the subject of insect-borne diseases, as it was the first publication of importance to record experimental data which proved beyond doubt that disease can be carried by insects; thus paving the way, not only for a new line of investigations into animal diseases, but also into human and plant diseases as well.

In studying the blood for the demonstration of the parasite of Texas fever, it is better to use some stain which will color the parasite and not the blood corpuscle. This will render it easily visible, and moreover, there are other bright bodies which occur in the blood corpuscles of cattle, in a state of health, which might confound the observer. These bodies do not take up the stain, and therefore, when the stain is used no mistake will occur. The stain which was first used by Smith,

* "Investigations into the nature, causation and prevention of Texas or Southern Cattle Fever."—U. S. Dept. Agr. Bureau of Animal Industry, Bulletin No. 1, 1893.

and which has given general satisfaction, is an alkaline solution of methylene blue. It is prepared by adding to one ounce of a saturated alcoholic solution of methylene blue, three ounces of a solution of caustic potash in water, of the strength 1:10,000.

A blood preparation for study is prepared as follows: The hair is clipped from a nickel-size space on the ear or rump. The skin is cut through with a fleam, and a drop of the blood which wells up from the wound is transferred to a clean microscopic cover glass. This drop of blood is then spread in a very thin layer by laying upon it another cover glass and pulling them apart. The films thus prepared are quickly dried over a lamp or other heater, and then passed through the flame of an alcohol lamp slowly, three times, to "set" the specimen. A drop or two of the stain is put on and in about a minute is washed off in water and allowed to dry. The preparation is now ready for examination with a microscope magnifying one thousand diameters, after it has been mounted upon a glass slide in Canada balsam.

THE CATTLE TICK.

Has a very wide geographical distribution in the United States, and is a standing menace to the cattle industry of the North and West. (See map.) As soon as it was established that the tick was the carrier of the disease the Federal Government established a quarantine restricting the movement, North and West, of cattle from all territory where it could be shown that cattle ticks were found. This quarantine puts certain Southern states wholly south of the line, and designates them as *permanently infested territory*. In states through which the quarantine line runs, part of the state is above the line, and therefore not quarantined, while

that portion of the state south of the line is quarantined. In other words, the quarantine line does not follow the northern boundary line of the tick-infested states, and portions of some states have, therefore, an internal as well as external quarantine. The following states were wholly south of the quarantine line in 1900: South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Indian Territory, while parts of Virginia, North Carolina, Tennessee, Oklahoma, Texas and California are above the line. In other words, the northward extension of the *permanently infested territory* is limited by climatic conditions. Although a large portion of the South is quarantined the greater part of the year, there are many tick-free pastures in every Southern state. This was recently verified on the Station farm. Some yearlings had been practically raised around the barns and had only had the run of a sandy lane where any ticks that fell from the cattle returning from tick-infested pastures would perish in the hot sand. These young cattle were finally turned upon an unfenced pasture recently acquired by purchase for the college. In a few days the largest heifer was found dead. A microscopic examination of the blood showed she had died of acute Texas fever. This experience is probably repeated frequently in Florida and elsewhere in the South, resulting in the death of thousands of cattle every year. Had this animal been repeatedly infested with crops of ticks from birth, she would have been immune to Texas Fever, and could have been placed upon a ticky pasture with impunity.

The life-history of the cattle-tick is about as follows, according to Dr. Cooper Curtice: The ripe female falls off the cattle, and after the second day lays eggs for two weeks, (about 2,000 in number), when hatching begins which occu-

pies three weeks, that is, the eggs first laid, hatch first; the young ticks or seed ticks lie in wait for cattle, hidden under leaves or resting in clumps upon the ends of blades of grass. These crawl upon passing cattle and remain attached to them for three or four weeks when, having reached adult size, they drop off, lay their eggs and die; the cycle of time from egg to egg-laying being about six weeks. These eggs are oval and quite small, being about 1-50th of an inch long and 1-70th of an inch in diameter, and are brownish-red in color. When the female tick is in the act of egg-laying, she remains quiet for three or four days, when a few eggs will be noticed on the mouth. The size of the egg-mass increases day by day, and as a rule the number of eggs varies with the duration of the egg-laying period. To the casual observer it would appear that the eggs came from the mouth of the tick, but they in reality emerge from the genital pore which is situated in the space between the second pair of legs on the under surface of the body. The young ticks as they emerge from the egg shell are quite small and are difficult to detect under the hair of an animal, without the aid of a magnifying glass. However, they are very active at this stage, and can cause the fever. At this time they have only six legs. Their further development depends entirely upon their getting upon an animal. They soon develop a fourth pair of legs and remain until maturity upon their host. Although the young ticks, or seed ticks are quite active, neither they nor the adult ticks ever crawl any considerable distance. They must either be transported by an animal, be washed distances by rains, or be carried by other means, such as cattle trains, hides of ticky cattle air currents. Hence, we find one pasture ticky and therefore a menace to all cattle grazing in it, another not, according as the chance for its infestation has existed by some of the means enumerated above.

TEXAS FEVER IN FLORIDA.

Many Floridians know through experience that there are certain precautions to be observed in bringing cattle into the State from Northern points. These are that they should be brought late in the fall, or that they must be brought here as sucking calves or just after they have been weaned. Those who disregarded these conditions know to their sorrow that the losses are great. They are not all aware that the tick, which we have always with us, is responsible for the deaths of their imported stock. It will thus be seen that the time of bringing northern-bred animals into Florida is limited to a few months in the year. Southern cattle that have been infested with ticks from birth do not take the fever; but Southern cattle which have not been regularly infested with ticks will take the fever as quickly as a Northern animal and die just the same. A Southern animal raised upon a tick-free pasture will, in all probability, die of Texas fever the first time it is allowed to graze upon a tick-infested pasture. This means that the Southern animal is only immune to the fever when it has been ticky from birth. These conditions have deterred stockmen and farmers from trying to improve the cattle breeds upon any extended scale and has resulted in much inbreeding and the scrubby cattle noticed everywhere in the State. Sometime ago a carload of twenty-seven head of graded bulls of several breeds were bought in the Chicago market and shipped to Kissimmee. A short time after their arrival a mysterious disease developed. I was summoned to investigate the outbreak and found they were dying of acute Texas fever. Just half of them died. This experience has probably been repeated by others; but one experience of the kind generally converts the owner to the tick theory in the production of the fever. Another man purchas-

ed some blooded stock in Tennessee. He lost three and all had the fever. The balance are now recovering from the chronic form of the disease. Although these were Southern cattle and were supposedly immune to Texas fever they were probably raised on tick-free pastures, or in that part of Tennessee which is above the quarantine line. At any rate they were insufficiently protected by previous tick infestations to withstand the ticks in Florida. Although the Southern animal, if kept under the conditions indicated in the foregoing remarks, is believed to be immune to Texas fever, there can be no doubt that this fever kills more cattle in Florida than all other diseases combined. There are very few epidemics, except in the cases of animals brought here under improper conditions, but deaths from the disease are always occurring here and there, one or two at a time, and little attention is paid to the matter. This means that in the aggregate thousands of animals die annually not only in Florida, but all over the South from a disease to which they should be immune, it being entirely preventable.

How to prevent the disease in native cattle is the question of immediate importance to the largest number of stockmen at present. It has been stated before in this bulletin that cattle which have from birth up been infested with successive crops of ticks (the brown-headed variety) will not die from Texas fever. Were this not true, there would be very few cattle in the South. Because the vast majority of cattle in Florida do not die of Texas fever and because there is no general epidemic of the disease here, little is known of its existence. Could all the deaths of cattle be reported and investigated Floridians would probably be surprised at the results, which would, no doubt, show that Texas fever had claimed nine-tenths as victims. It will be seen from what has been said that the way to prevent

our native cattle from dying from Texas fever is to see that they are infested with the cattle tick at least once every year, and that this periodical infestation must begin early in life. This is, of course, what occurs under natural conditions. Deaths occurring early in life among cattle from Texas fever, means the cattle were not infested with ticks early enough, that they were raised on pastures where there were no ticks. Because, however, most pastures are ticky, cattle which have been raised on tick-free ones, are always menaced when changed to a fresh pasture. This explains why the movement of cattle from one section to another is sometimes attended with sudden and unaccountable deaths. How, then, can a man in one county safely bring cattle from another to his own farm which he knows is tick-infested? The answer is plain. Buy only those cattle upon which he sees the cattle tick, or those which show the marks of previous infestation. These can be plainly felt as little elevations upon the udder, upon the skin of the thighs just behind the udder, or upon the dew-lap.

It is plain, then, that the best way to prevent Texas fever in native animals is to see that they are infested with ticks from birth. It is equally plain that if a cattleman has a tick-free farm, his cattle raised upon that farm will be susceptible to Texas fever. That if he buys a ticky animal, the farm will become infested, and his susceptible animals will take the fever, and some of them will die. It is not to be inferred from what has been said regarding the willful tick-infestation of cattle that all cattle are to be subjected indiscriminately to the ticks. It is only young calves which may be thus treated. Should older animals, say those ranging from one year old and upwards, become infested for the first time, some may die. The management of adult susceptible animals which are liable to become infested

will be discussed in another paragraph under the heading "Immunization by tick-infestation."

How to determine the true cattle tick.—There are eight species of ticks which infest cattle in the United States. They are so much alike, especially the large ones (females) that none but an expert could decide definitely, were it not for the fact that the true cattle tick is most numerous and has the widest distribution. While it is called the cattle tick, it is not found upon cattle alone, but also upon horses, occasionally. The true cattle tick which carries the germ of Texas cattle fever has a chestnut-brown head, and when one wishes to take cattle of any age into a new territory, he should ascertain whether they have been previously infested with such ticks, and whether the new territory is also infested with the same tick. If his cattle have not been thus infested and if the new territory is infested with them, he may expect to lose some of his cattle with Texas fever.

IMMUNIZATION BY TICK-INFESTATION.

Immunity to Texas fever by tick-infestation may occur in two ways. One is by the natural method. This is the way in which the vast majority become immune. The other method is by placing the young ticks upon the animal by hand—or by artificial tick-infestation. To do this a few large female ticks, (male ticks, are quite small) are removed from an animal placed in a fruit jar containing some moist earth and covered with a piece of cheese-cloth. In a few days they will begin laying eggs to the number of about 2,000 each, and when they have finished they will die and dry up. In a few weeks the eggs will hatch out if kept in a warm, moist place. These seed ticks, which have but six legs, can never develop into adult ticks, which have eight legs, unless they get

nourishment from cattle or horses. They will live as seed-ticks for about four months under favorable conditions of heat and moisture. To give the young calf his first dose of ticks, a few of these seed-ticks, about one hundred or more, are counted and placed upon the animal's back. Being quite active, they soon disperse and fasten themselves. If too many are placed upon the animal, it may take a fatal form of the disease. Because this procedure approaches the natural method most closely, it is supposed to be the safest one to use.

The immunization of adult cattle by artificial tick-infestation is a more dangerous proceeding, but can be done under proper supervision with comparative safety as the following letter from Mr. C. W. Ward, Secretary of The United States Land Company, of Washington, D. C., shows. He says, under heading and date, Washington, D. C., July 11, 1902:

"Senator Carson, of Kissimmee, has forwarded your letter regarding the Jersey cattle which we took to Florida last year, to me, with request that I write you.

"I take pleasure in informing you that we have had no trouble whatever with the two Jerseys since about last February when I sent samples of blood to you, through Senator Carson, for examination.

"Last fall we shipped a four-year old cow, a two-year old heifer and a six-months old bull from the Miller & Sibley Prospect Farm, Franklin, Pa., to Kissimmee, Fla. Ten days after their arrival at Kissimmee the two year old cow died quite suddenly with symptoms of Texas fever. The young bull has never shown the least ill effects from the change, neither has the four year old cow, with the exception that she aborted her calf at seven months. I was there at the time, found quite a good many ticks on these animals, and being anxious to know

whether or not the fever was in their blood, I sent samples to you as stated above for examination, receiving the report from you that the blood of both animals showed Texas fever germs. The method that I pursued with these animals from the first (after the death of the other one) was to keep them for the greater part of the time, for the first three months, in a tick-tight enclosure, allowing a very few ticks on them at first. Then we turned them out to pasture before the hot weather came—gradually leaving them out until finally we paid no attention to the ticks whatever. They are apparently immune now. The cow should drop another calf early in December and if you care to hear further, I will be pleased to let you know about the first of January what the conditions are.

(Signed) Very truly yours,

C. W. WARD.

The great danger in allowing ticks to get upon the animals under natural conditions is that too many may attack an animal and cause a fatal infection. It is far safer to pen the animal and regulate the number of ticks. This can be done as before stated by hatching the eggs and placing about one to two hundred ticks upon the back of the animal. This is best done in the cooler months so as to escape the debilitating influences of summer weather. If a sucking calf is brought into Florida from the North, its chances of withstanding the onslaught of the tick are good. Needless to say an excessive number of ticks should not be allowed to remain upon it. This, indeed, applies to all animals, as there can be no doubt that ticks, as they are seen sometimes, by the thousands, upon cattle, do much to cause unthriftiness by the abstraction of blood, and by irritating the skin. In nearly every fatal case of acute Texas fever which has come under my notice, in Florida, no large ticks have been no-

ticed. This is because the animal died before they could develop. The small ones could be seen by raising the hair and examining with a magnifying glass.

Immunization by blood-injections.—If blood from an animal suffering with Texas fever be injected into another susceptible animal, it will contract the fever. This is also true of the injection of blood from a Southern, healthy, tick-infested animal into a Northern or other susceptible animal, because the blood of all Southern tick-infested cattle contains the germ of Texas fever. This fact is taken advantage of as a means of immunising animals without the direct agency of the tick, as by this method also an animal may be given a non-fatal attack of true Texas fever which confers immunity. Both these methods of immunization were first demonstrated by Professors Smith and Kilborne in their report before referred to. The methods have been repeated since by the Australian government, and by the Experiment Stations of Missouri, Texas, Louisiana, Mississippi and Alabama on a sufficiently large scale to prove their economic value.

THE BLOOD-INJECTION METHOD OF IMMUNIZATION.

The animal which is to supply the blood should be healthy, three or four years old, and must have supported successive crops of ticks from birth. Such an animal is easily found in Florida. The hair is shaven from the neck, over the jugular vein; the neck is washed with soap and water, a five per cent. solution of carbolic acid, and then with water which has been boiled. Put a strap around the neck and draw it tight. Place under it and over the jugular vein a block about an inch square. This will cause the vein to swell. Insert into the jugular vein a large hypodermic needle to which is attached a piece of small rubber tubing, both

of which have been boiled to sterilize them. The needle must point toward the head. Blood will now flow, and it is to be caught in a clean tumbler and stirred with a small bundle of wires. After stirring for a minute or two, fibrin will collect upon the stirrer, and the blood will have lost its power of clotting. Then strain the blood through a clean piece of cheese cloth tied on the top of a second tumbler which is to be placed in a pan of water and kept at blood heat. A sterile 1cc. hypodermic syringe with a strong needle is filled with the blood and the contents are injected under the skin of the shoulder. The place of inoculation should be cleaned in the same manner as that from which the blood was obtained. It is also of importance that the blood be kept at body temperature during the process. After the operation all the utensils used should be cleaned of blood and washed with carbolic acid solution. The operation must, on no account, be delayed after the blood is drawn. Sixty days after the first dose, a second dose of 2 cc. may be given, although some give only the one dose. The second dose is indicated where the temperature of the inoculated animal did not rise to 105 degrees F. In a typical case produced by this means, the fever commences in a week, showing a rise to 106 degrees F., which continues for from five to fifteen days more, when it falls to the normal, about 102 degrees F. About the thirtieth day after injection a secondary milder fever, or a relapse, occurs which lasts several days. The best time to do this work is between November 1st and March 1st, according to Dr. Cary, of the Alabama Experiment Station. He also advises allowing a mild infestation with ticks two months after the inoculation, and keeping off an excess of ticks during the hot summer months. This is best done by pasturing on fields where ticks are known not to be plentiful, or by applying once weekly to

the dew-lap, udder and escutcheon, crude Beaumont oil, or a 20 per cent. kerosene oil emulsion. The report of Drs. Francis and Connaway, of the Texas and Missouri Experiment Stations, where this work was carried on jointly on a large scale, shows that of 1,500 animals inoculated by them, only 3 1-2 per cent. died from the inoculation fever, and less than 7 per cent. by exposure to tick-infested pastures after they had recovered from the blood inoculation; a loss of about 10 per cent. in all. In Texas, the animals were placed in large pastures where no attempt was made to keep down excessive tick-infestation. At the same time Northern animals placed on the same pastures without being immunised had a mortality of from 50 to 90 per cent. It is highly probable that where the infestation subsequent to inoculation can be governed a still smaller percentage of loss would occur. In Texas the inoculated animals ranged from a few months to a year old; yearlings being preferred.

TREATMENT OF TEXAS FEVER.

As regards the treatment of the acute form of fever there is, unfortunately, little to be said. Such havoc is played with the blood that the animal has very little chance of recovering. We might well say there is no successful treatment for an acute case of Texas fever. As it is a blood disease attended with high fever and general depression, tonics, febrifuges and stimulants are indicated. For these the following might be given to a full grown animal: For the fever give one to two drachms of sulphate or the bisulphate of quinia dissolved in six ounces of water and four ounces of whiskey, every three hours. For the constipation give as a drench Epsom salts, one pound, ground ginger, one ounce

common salt, two ounces, syrup, one pint, water, one pint. If the animal refuses food, force down eggs, milk and whiskey every few hours. Follow this treatment, if the animal seems to improve, with a general tonic as follows: Sulphate of iron, one ounce; gentian, two ounces; bicarbonate of soda, three ounces; ginger, three ounces; sodium chloride, two ounces. Mix, divide into twelve parts and give one three times a day in one-half pint whiskey and one pint of water. If dangerous bloating occur, puncture the rumen on the left side between the last rib and the hip bone, with a pocket-knife, if a trochar is not at hand. It will be necessary to spread the wound open with a quill or wire spring to allow the gas to escape. Then give any one of the following to prevent the re-formation of gas; four ounces bicarbonate of soda, or two ounces of aromatic spirits of ammonia in water, or two ounces of chloride of lime in water.

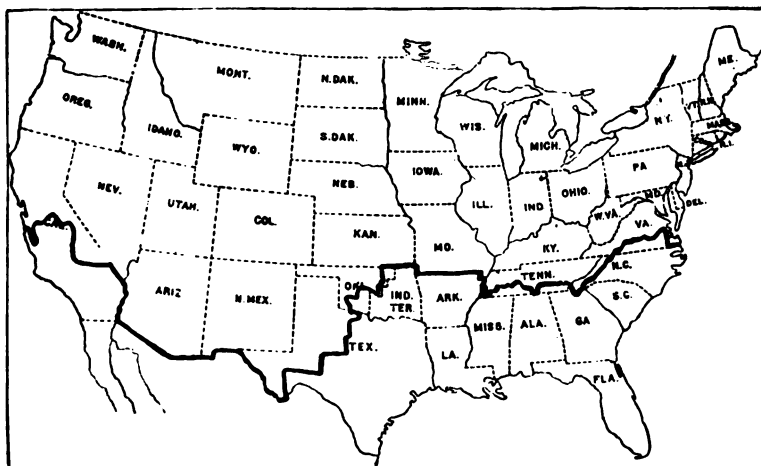
One other procedure could be tried, in case of a valuable animal. This is the transfusion of all the blood from an old immune native into the sick animal, allowing its blood to flow away from the opposite vein; or the immune native might be bled, its blood defibrinated, strained and while warm, injected into the jugular vein of the sick animal. This procedure could, of course, be carried out only by a veterinarian or physician.

Treatment of the chronic form.—Not all cattle which contract Texas fever die; but the disease frequently assumes the chronic form, running a course of several months. Such animals are emaciated, the blood is very thin and pale, the appetite is poor, there are gaseous eructations, some dropsical swellings and accumulations of liquid in the serous cavities. In fact the conditions found are in ratio to the amount of anaemia. If this is extreme, we find extreme emaciation, or a condition better expressed by the term *poverty*. For such cases there is some

hope if the disease has not run too long. In these cases we must prescribe materials which are not only useful in building up the system, but which are palatable as well. I have had success in the treatment of several cases with the following condition powder. It has the great advantage of being palatable and can be mixed with the feed. There are animals which have never learned to eat anything but grass or hay in some form. These, of course, would either have to be taught to eat the bran containing the powder, or be medicated by hand. The following is the formula of the powder: Linseed meal, eight ounces; powdered foenugreek seed, four ounces; powdered ginger-root, three ounces; common salt, four ounces; hyposulphite of sodium, two ounces; sulphate of iron, one ounce. These are thoroughly pulverized and mixed. The dose is a small handful in bran morning and night, there being twenty-four doses in the mixture.

SALT-SICK.

As far back as the memories of the oldest inhabitants of Florida go, there has existed a cattle disease which is called salt-sick. This disease seems to be most prevalent in the central portion of the peninsula, or "back-bone" of Florida. Some claim that it exists only in that region, but my correspondence indicates that it may be found in all parts of the State, and that there is no close agreement upon the part of stockmen as to its true cause. Many animals die of this disease, and occasionally one recovers even after being sick for a year. It may affect cattle of any age, but it chiefly attacks calves and yearlings, according to my information gained from personal observation and from correspondents. It is by no means confined to such animals. The symptoms I have observed are about the same as those given further on.



(Compiled from Government reports.)

Outline map of U. S. Approximately all territory south of the heavy line crossing the country is permanently infested with the cattle tick



(Photo. by Prof. H. H. Hume)

THE SALT-SICK COW.

MOU

An investigation* of this disease was made under the auspices of the Florida Agricultural College by Professor Stockbridge, assisted by Drs. French and Ennis.

They came to the conclusion that "salt-sick is not a specific disease, but rather a condition resulting from improper environment, especially insufficient nutrition; that the condition is most prevalent at the end of the winter season, when animals have been for several months confined upon range or pasture consisting of the dry wire-grass and other inferior vegetation of the sand ridge portion of the State; that the disease is distinctly digestive in character, has its seat in the alimentary canal and finally develops into chronic inflammation of the small intestine, resulting in mal-nutrition, anaemia and frequent death from starvation; that the symptoms show those generally attendant upon chronic anaemia; loss of appetite, emaciation, abnormal appetite, craving foreign substances such as sand, earth, bones; diminishment of red corpuscles, swellings or ulcerations under the jaw; bloodless appearance of mucous membranes inside the mouth and eyelids." They suggest as treatment alimentary correctives and tonics and used successfully air-slaked lime one-half ounce, sulphate of iron, one-sixth ounce in three gallons of water, to be given the animal as a drink instead of the usual water. They also recommend a change of pasture.

From what I have seen of "salt-sick" and from what we know of Texas fever, the role which it should play in diseases of cattle in the South, and especially in Florida, where the tick is ever-present, I am forced to believe that "salt-sick" is chronic Texas fever and that the conditions named by Dr. Stock-

*Florida Experiment Station Report 1900-1901, pp. 43-58.

bridge as being the cause of the disease are not the *sole* causes, but are contributing causes. The loss of appetite which occurs early in "salt-sick" cannot in all cases be attributed to poor pastures and it would occur, regardless of pasture conditions, in an animal attacked with Texas fever.

In all cases of "salt-sick" where I have had an opportunity of making a post-mortem examination, I have found the appearances to be those which are attendant upon the extreme anaemia which follows an attack of Texas fever. These are pale, watery blood, dropsical conditions, light-colored, bloodless liver and extreme emaciation. Most important of all was the occurrence in fairly large numbers of the germ of Texas fever in the red blood corpuscles, in the omental fringes, and of ulceration of the pyloric end of the fourth or true stomach.

In 1896, Professor William Williams, of New Veterinary, College, Edinburgh, assisted by his son, T. A. Williams, investigated a cattle disease in the island of Jamaica, for the British government. Their description of the disease fits very closely our "salt-sick." In Jamaica it is called the "wasting disease." These investigators also found the germ of Texas fever in the blood and stated that the disease is a form of Texas fever. This preliminary statement concerning "salt-sick" may be ended by saying that several cases have been cured by the use of the powder advised for chronic Texas fever. It is highly probable that in those cases where the anaemia is profound the damage to the blood and other organs is irreparable and treatment is almost useless.

Recapitulation.

1. Texas cattle fever, the most important cattle disease in Florida, is carried by the common cattle tick. The disease can also be transmitted by the mechanical transference of blood

from a sick to a well, susceptible animal; the blood corpuscles being the place of residence of the germ which causes the disease.

2. All bovines, irrespective of place of birth, are naturally susceptible to Texas fever; this susceptibility increasing with age. Even though the parent be immune, this immunity is not conferred upon the offspring.

3. All cattle, whether Northern or Southern, acquire immunity to the disease from non-fatal attacks which may be produced by natural tick-infestation, artificial tick-infestation, or by the injection of small quantities of blood from an animal that has had the disease.

4. One animal can not *catch* the disease directly from another. It must be carried, and is carried *only*, so far as our present knowledge goes, from one sick animal to a healthy one, by the common cattle tick.

5. The cattle tick does not crawl any considerable distance, but generally stays where dropped and lays her eggs, which hatch out in time. The young or seed-ticks then get upon the first animal that passes. The old ticks cannot re-attach themselves, once they have let go. Their legs are too short. Ticks will not crawl over a fence rail. Therefore one pasture may be disease-producing, and another adjoining it, not.

6. In Florida it is wise to allow a moderate number of ticks to get upon cattle every season.

7. No ticky animal should be introduced into a herd which is known to have been raised upon tick-free pastures.

8. If your cattle are, or have been ticky, and you to wish to introduce fresh cattle, see that the new cattle bear either the cattle ticks, or show the scars of previous tick-infestations.

9. Cattle may be brought into Florida with comparative

safety as suckling calves. If older, they should be brought in between November 1st. and March 1st. and infested artificially with newly hatched cattle ticks, as per method described elsewhere in the bulletin.

10. Cattle cannot be brought into Florida during the hot months profitably. Nor should artificial immunization be attempted at that time.

11. Pregnant cattle generally abort when attacked by Texas fever.

12. Immune cattle after a time (two or three years) lose their immunity and may contract the fever when they again become ticky.

13. Treatment of acute Texas fever is, as a rule, useless. The chronic form will generally respond to tonics such as those given in this bulletin.

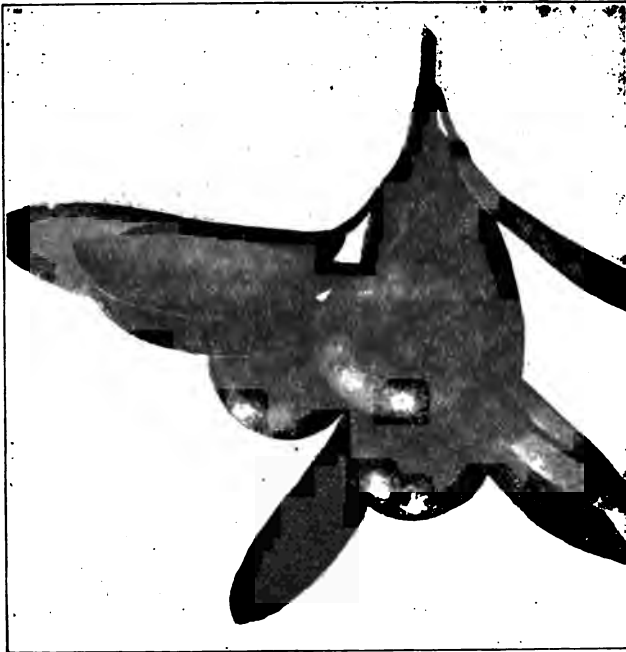
14. The writer believes that the so-called "salt-sick" is mainly due to ticks, that it could be more appropriately called "tick-poverty;" that the disease is primarily chronic Texas fever, and that poor pastures are a contributing cause.

BULLETIN NO. 65.

DECEMBER 1902.

FLORIDA
AGRICULTURAL EXPERIMENT STATION.

THE KUMQUATS.



Marumi Kumquat.

By H. HAROLD HUME.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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1903.

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LOUIS DEGOTTRAU, Supt. Citrus Experiments at Boca Raton.

*Supt. Farmers' Institutes.

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The kumquat was not known in Europe previous to its introduction into England by Mr. Fortune in 1846. Sometime within four years of that date it was brought to America.

Scientific and Common Names..... 556

This fruit should be known as *Citrus Japonica* Thun., and the recognized common name in America is kumquat.

Description of the Tree..... 557

As a budded tree it reaches a height of from eight to twelve feet. The flowers are produced for the most part on wood one year old. They are small, white and sweet scented. A native of Cochin China.

Varieties..... 558

Two varieties are known in Florida. Nagami (oblong) and Marumi (round.) They are easily distinguished in habit, leaf and fruit. Nagami is probably the more desirable.

Size of the Kumquat Tree..... 559

The largest tree observed in Florida was ten feet, nine inches high and ten feet eight inches across the branches.

Stocks..... 560

For northern Florida, *Citrus trifoliata* is recommended, and for the southern portion of the state, sour orange, pomelo and rough lemon or rough lemon sprouts from roots already bearing another top.

Hardiness of the Kumquat..... 562

Hardier than most citrus fruits. Will withstand almost or quite as much cold as the Satsuma. Recommended for planting in North Florida.

CONTENTS AND SUMMARY.

Distance apart to Plant..... 563

Plant from eight to twelve feet apart. In hedge form five feet apart in the rows with rows twelve feet apart.

Pot Culture..... 563

The kumquat is a useful ornamental which may easily be grown as a pot plant. Bud on trifoliata stock. The mealy bug, *Dactyloupus citri*, may be held in check by using whale oil soap, tobacco juice, or by spraying frequently with pure water under strong pressure.

Picking and Packing..... 564

Pick with or without leaves attached. Pack in quart baskets and ship in strawberry crates. The demand is limited.

Uses..... 565

Eaten raw or as a preserve. Used 'n decorations.

The Kumquats.

Introduction Into Europe and America.

The introduction of the kumquat into Europe appears to have been quite recent. Galesio seems not to have known it. Risso and Poiteau make no mention of it in their exhaustive work, "Histoire et Culture des Orangers." Since none of these writers refer to the kumquats, we are safe in concluding that they were not growing in Europe at the time they wrote. So far as the author has been able to find out, the kumquat was introduced into Europe by Mr. Fortune, a collector for the London Horticultural Society, who brought it with him from China to London, May 6, 1846.* The oblong variety appears to have been the only one introduced by him, for in his remarks, published in the Journal of the London Horticultural Society, page 239, 1848, he says, "The fruit ripens late in the autumn, being then about the size of a large oval gooseberry." Very soon afterward specimens of the kumquat must have been forwarded to America. A. J. Downing in his Horticulturist of February, 1850, pages 375-377, gives a description of the variety Nagami with illustrations and quotes largely from the remarks of Mr. Fortune. He further makes the following statement: "We have a small tree growing on our own grounds, which was kindly sent us by Mr. Ranch, exotic florist, near Greenwood cemetery, Brooklyn. We believe Mr. Buist, of Philadelphia, and probably

* The Kumquat was one plant of a lot collected in the districts of Foo-chow-foo, Chusan and Ningpo, China. See, Fortune, R. Sketch of a visit to China, in search of New Plants. Jour. Hort. Soc. Lon. 1: 223, 1846.

other men, now have it for sale, so that amateurs can make trial of it in various parts of the country." Some time later, probably very shortly after this date, it was brought to Florida. Since then several importations have been made by various nursery-men. The original trees imported by G. L. Taber, of Glen St. Mary, in 1885, were still standing in his grove in the autumn of 1901. Reasoner Bros., of Oneco, imported the variety Nagami in 1885 and the Marumi in 1890 from Japan.

Scientific and Common Names.

The following scientific names have been applied to the kumquat:
Malus Limonia, fructu pumilo aureo Kaemp. Amoen., exotic, 801.
 1712.

Limonellus Madurensis Rump, Fl. Amboyn. 2:110. t.31. 1741.

Citrus japonica Thunb. Fl. Jap. 292. 1784.

Citrus japonica Murr. Linn. 2: 697. 1784.

Citrus Madurensis Lour. Fl. Cochinchina. 467. 1790.

Citrus Margarita Lour. l. c. above.

Citrus japonica Wild Spec. Plant. Linn. 3: 1426. 1803.

Acumen japonicum Gall. Traite du Citrus. 182. 1811.

Citrus inermis Roxb. Fl. Ind. 393. 1832.

Kaempfer's description consists of a single line, "*Malus Limonia*, fructu pumilo aureo, medulla dulci." It is highly probable that this refers to the Kumquat and besides the common name Kin Kan is given as noted below.

The description given by Rumphius coupled with the figure, t.31, leaves no room to doubt that his *Limonellus Madurensis* is the round kumquat, as we know it. Credit cannot be given either to Kaempfer or to Rumphius, however, as they did not refer it to its correct genus. Under the name of *Citrus japonica* this fruit was described by Thunberg in 1784 and his is the accepted botanical name. Murray described the kumquat under the same name in 1784, but credit cannot be given to him, for although the year is the same, Murray refers to Thunberg's description, which is proof of the priority of the latter's publication. Under the name *Citrus Madurensis*, Lourerio in his Flora of Cochinchina described the variety Marumi (round) and under *Citrus Margarita* the variety Nagami (oblong). Willdenow in his Species Plantarum simply copied Thunberg's description. Galesio in his Traite du Citrus bases his remarks upon descriptions of Lourerio and Thunberg, but apparently had never seen the fruit. Roxburgh wrote his description from plants growing in the botanical garden at Calcutta, India.

Quite a number of common names have been given for this fruit. Thunberg gives the common name *kinkan* (l. c. above).

Lourerio gives the common names *Kin Kuit*, *Kin* and *Kuit Xu* for the round fruit and *Chu tsu* and *Chantu* for the oblong form. Kaempfer gives the common names *Kin Kan* and *Fime Tats banna*, while Roxburgh uses the common name kumquat. Siebold and Zuccarina in their *Flora of Japan*, page 35, 1826, give the common names *kin kan* or *kin kit* to the round variety, while to the elliptical or oblong one the name *too kin kan* is given. It might be added that Siebold and Zuccarina give a better illustration of this fruit than has been published in any other work. The commonly accepted name for this fruit throughout the United States is *kumquat* and this appears to be the common name in India. Kumquat, sometimes spelled "comquot," is a Chinese word meaning "gold orange" and the Japanese equivalent is "kin kan."

Description of the Tree.

Citrus Japonica Thunb. A shrub reaching a height of from 8 to 12 feet, much branched, the head rather close and compact, branches when young light green, somewhat angled, becoming rounder with age, leaves 3-8x1 1-4 inches to 1 5-8x3 3-8 inches lanceolate; apex obtuse; base acute or obtuse; margin very slightly crenate down about half way from the apex; upper surface dark green, glossy; lower, lighter. Flowers white, axillary, single or in pairs, sometimes as many as four, produced on one year old wood; calyx small, not lobed but five pointed, greenish; corolla white, five parted, dotted with oil cells, margins incurved; stamens 15 to 20, unequal in length, united into two or three groups; pistil five or six loculed; flowers delicately sweet scented like those of the orange; fruit round or oblong, 1 to 1 1-4 inches in diameter, five or six celled; oil cells of the rind large and conspicuous; juice acid; seeds small, pointed; cotyledons greenish. Presumably a native of Cochin China, extensive-

ly cultivated in China and Japan, where the fruit forms an important ingredient in various preserves and sweetmeats.

Varieties.

NAGAMI—*Oblong, olive-shaped*.—Tree dwarf, eight to twelve feet, bushy; young branches somewhat angled, light green; leaves 1 1-2x3, 1-2 or 3-8x1 1-4 inches, lanceolate, apex obtuse; base acute or obtuse; margin crenate down about half way from the apex; veins inconspicuous; upper surface dark green, glossy; lower lighter; borne on rather stout usually very slightly margined petioles 1-4 to 5-8 inches in length. Fruit small; obovate or oblong; 1 1-4x3-4 inches, 1 1-2x1 inch, 1 3-4x1 1-8 inches, 1 3-4x1 3-16 inches, golden yellow; stem short; calyx small; rind smooth, aromatic, spicy; oil-glands large; juice acid, sparse; sections usually five; seeds 2 to 5 oval, 1-2 inch long, greenish; cotyledons two, green; season, October—January.

MARUMI—*Round*.—Tree similar to Nagami, except that it is slightly thorny, and has the leaves somewhat smaller and rounder at the apex. Leaves, oval; apex obtuse; base obtuse; margin crenate half way down the length; veins slightly more conspicuous than in Nagami, borne on short, rigid, inconspicuously winged petioles 1-4 to 1-2 inch in length. Fruit spherical or somewhat oblate, 1 to 1 1-4 inches in diameter; golden yellow, short stalked; calyx small; rind smooth, thin, spicy to the taste and aromatic when bruised; oil cells large; pulp sparse; juice acid; sections four to seven; seeds, small, oval, greenish, 1 to 3 in number; cotyledons two, greenish; season, same as Nagami.

When eaten raw both varieties have a very pleasant flavor or combination of flavors. The juice is acid; the rind has an

agreeable spicy taste; while the soft white granular inner portion of the rind is decidedly sweet. There is a slight difference in flavor between the two varieties but it is better determined by taste than described in words. Of the two, the Nagami is generally considered to be the more desirable, though among growers there is a difference of opinion. The fruit of the Nagami is more regular in size on young plants. Large sized plants of both varieties bear about the same amount of fruit of uniform size.

The Size of the Kumquat Tree.

The largest and most symmetrical kumquat bushes with which the writer is acquainted are those growing in the grove of Mr. John Thompson, at Clearwater, Fla. The following are the actual measurements taken Dec. 10, 1901.

Nagami, height 10 feet, 9 inches; distance across the head, 10 feet, 9 inches; stock, rough lemon.

Nagami, height 9 feet, 3 inches; distance across the head, 11 feet, 8 inches; stock, rough lemon.

Nagami, height 8 feet, 2 inches; distance across the head, 8 feet; stock, sweet.

Marumi, height 8 feet, 8 inches; distance across the head, 8 feet; stock, pomelo.

These were budded in 1894 on two year old stocks and were set out in their present position and started growth in the spring of 1895. The tops are round and symmetrical as the measurements would indicate and the branches sweep the ground.

A large Nagami kumquat may also be seen on the grounds of Reasoner Bros., at Oneco, Fla. The specimen is 10 feet high and 10 feet 6 inches across the top while the trunk is 4 inches in diameter just above the union with the stock. The stock is a rough lemon shoot. The tree is badly shaded and the top, in consequence, is not symmetrical but it bears well. At the time it was

observed and measured (December, 1901) it was carrying a crop of from three thousand to three thousand five hundred fruits, of which it takes from forty to fifty to make a quart.

Seedling kumquats would not attain the size of those budded upon strong, vigorous stocks.

Stocks.

Since the kumquat is decidedly dwarf and shrubby it is by all means preferable that it be budded upon a vigorous stock, thereby increasing its size and bearing capacity. The kumquat has been worked on all kinds of stocks used for citrus trees in Florida including *pomelo*, *sweet orange*, *rough lemon*, *sour orange* and *Citrus trifoliata*. On most of these the kumquat succeeds, but from time to time complaints have been made against the rough lemon stock, it being stated that the kumquat did not, in many cases, do well when worked upon it.

A number of kumquats on rough lemon stock planted on rather moist ground have come under personal observation in which it was found that there was a more or less copious flow of gum from the region just above the union of the stock and cion. In all cases where this occurred it appeared that the cion was the only part affected. The trees were in an unhealthy condition. The diseased condition, if we may so designate it, did not appear to be mal-di-goma, though in some respects it resembled it. The trouble may have been due to the fact that the great foraging power of the roots enabled them to collect, in certain soils, more food than the less rapidly growing top could readily assimilate.

On the other hand, on soils containing less moisture and presumably less fertility, a number of trees budded upon rough lemon roots have been examined which were vigorous and perfectly healthy. If one desires to use the rough lemon stock for

the kumquat on some soils the best plan would be to adopt the method used quite extensively by C. W. Butler, St. Petersburg, Fla. His practice is to insert kumquat buds in sprouts from rough lemon roots which already support and feed a sweet or mandarin orange top. A perfectly healthy union is secured in all cases as most of the food gathered by the roots is used by the larger and more vigorous top. Strange to say, however, the kumquat frequently outstrips the other top, sweet or mandarin orange as the case may be, in growth in height.

For the northern part of the state on most soils no stock is better adapted than *Citrus trifoliata*. Upon this stock it thrives and bears profusely, in four or five years forming a head as many feet in height. Regarding the stock used for the kumquat in China, Mr. Fortune, from whose remarks quotations have already been made, makes the following statement.* "The kumquat is propagated by grafting on a prickly wild species of citrus which seems of a more hardy nature than the kumquat itself. This fact should be borne in mind when the plant is introduced into this country; otherwise we shall have a comparatively hardy plant growing on a tender one." These remarks undoubtedly refer to *Citrus trifoliata*, the stock now so commonly used throughout Northern Florida for all varieties of citrus trees.

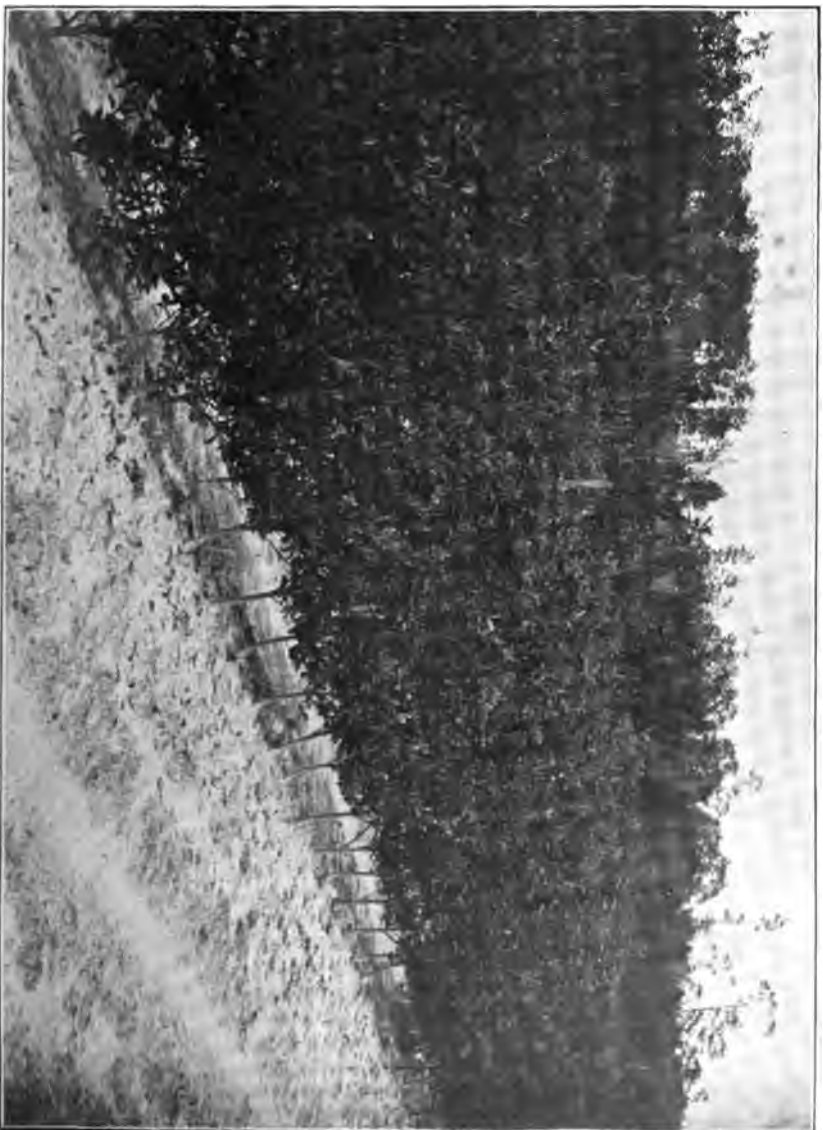
Sweet stock, on account of its susceptibility to the attacks of mal-di-goma should not be used. On some soils and in some localities the trees might continue to live and thrive for many years but there is no knowing at what time they may become diseased. The pomelo stock appears to be entirely free from mal-di-goma and it is well adapted to the kumquat.

* Jour. Lon. Hort. Soc. 3:239. 1848.

To summarize.—In Northern Florida use trifoliata stock and in the southern portion, sour orange or pomelo. Rough lemon may be satisfactory on some soils but on many it is not. It will be found to be quite satisfactory if the root throws a large portion of the food which it collects into some other top in the manner already described.

Hardiness of the Kumquat.

Mr. Fortune saw large numbers of these plants in Southern China where they were grown in pots, and said that it was a common plant in the nursery gardens of Fa-Tee. He believed, however, that it was of more northern origin for he had met with numerous groves of it on the island of Chusan and elsewhere in that portion of China. There it grew in far greater perfection than in the vicinity of Canton. Thus it would appear that the cultivation of the kumquat in China extends at least from latitude 20 to 30 degrees a range of 10 degrees. It might be noted here that the main portion of Japan lies between 30 and 48 degrees but the kumquat is cultivated probably only in the southern portions of that country. It must, however, be borne in mind that neither the climate of Japan nor of those portions of China to which reference has just been made is by any means so variable as ours. In Northern Florida the kumquat has proved quite hardy and it appears to be considerably hardier than most other members of the citrus family. The natural hardiness of the kumquat is increased by using *Citrus trifoliata* as a stock and the low dwarfish habit of the tree gives every opportunity for successful and economical protection. The best method of protection is that of banking. The bank should be placed about the trees in Northern Florida about the middle of December or earlier and should be



Kumquats in hedges as grown by G. L. Taber, Glen St. Mary, Fla.

100

Plate II.



Pot-plant.—Nagami.

allowed to remain until the end of March. The tree should be banked about half or three-quarters of the way up, leaving from one-half to one-quarter of the top exposed. It will not do to bank the tree completely over. This prevents respiration and transpiration and if it be done the trees will almost invariably succumb before the coming of spring. This has been proved to our entire satisfaction. The variety Marumi appears to be considerably hardier than Nagami.

Distance Apart to Plant.

The trees should be set from eight to twelve feet apart each way or they may be planted in hedge form allowing about twelve feet between the rows placing the trees about five feet apart in the rows. The latter method appears to give excellent satisfaction. It will probably be better in Northern Florida to plant the trees farther apart as it will be easier to secure earth for banking. The cultivation and care given the kumquat tree should be the same as for other members of the citrus family.

Pot Culture.

As a pot plant the kumquat is unsurpassed by any other species of citrus as a useful ornamental. The potting soil used at the Station has been composed of two-thirds of good hammock soil together with one-third thoroughly decomposed cow manure. This has given very good satisfaction, but any good soil will do. Two points in the growing of the kumquat in pots or tubs must be carefully looked after. The plants require a considerable amount of water. If they are allowed to suffer from lack of moisture the leaves will curl up and drop, the fruit will also fall, and frequently some of the smaller twigs die back.

The plants should not be allowed to become pot-bound, for if they do they will come to a complete standstill. Bone meal together with a little blood and potash makes an excellent fertilizer for the plants when grown in this way.

Plants intended for pot culture should be worked on *Citrus trifoliata* stock.

Considerable difficulty has been experienced in keeping potted kumquats free from the mealy-bug (*Dactylopius citri*). This insect does injury by sucking the juice of the plant and causing the fruit to drop. The bugs cluster about the stem close to the fruit and weaken it to such an extent that the fruit falls. Thrip juice or tobacco juice applied with a brush has been tried with good success, but constant attention is required to keep the plants free from them by this or by any other means. Syringing the trees with a stream of water under strong pressure has given good satisfaction. The ants have much to do with distributing the mealy-bugs, as they carry them about from place to place. The nests of the ants should be sought for and destroyed either with boiling water or with carbon bi-sulphide. Do not put the latter near the roots of trees as it is likely to injure or destroy them and kill the whole plant. Three or four feet from the trunk is generally a safe distance.

Picking and Packing.

The kumquat cannot be regarded as anything else than a fancy fruit, and in most cases a demand must be created. The package best adapted for shipping the kumquat is the strawberry carrier. Each quart basket may be lined with fancy fringed paper and the whole crate should also be lined with heavy paper. Fill each basket level full of the fruit and

place on top a small twig with two or three fruits attached. The fringed edges of the paper should then be drawn together to form a covering. Various styles of fancy packages holding a quart or less are in use.

Another method which has given good satisfaction is the one used by G. L. Taber, of Glen St. Mary, Fla. His plan is to cut the fruits with two or three leaves attached to each stem. They are then packed as already described. When put up in this fashion the package is very neat and presentable. Cut and packed as indicated (see Bulletin 63) they have frequently brought from seventy-five cents to a dollar a quart. It may, however, be stated that the demand is not unlimited and heavy shipments should not be made at any one time. The price usually obtained last season was twenty-five cents per quart. As already noted forty or fifty fruits fill a quart basket, but if the fruit is cut with leaves attached this number is considerably reduced.

Uses.

The kumquat may be eaten raw, and when served in small glasses holding three or four fruits they make a very pretty addition to the table. If cut with leaves attached they may be used as table decorations. In eating the fruit the skin is not removed, and the spicy, aromatic rind and acid pulp make a very delightful and palatable combination. An excellent preserve can also be made from the fruit, and the Chinese export considerable quantities put up in small stone jars.

The following recipe for preserving the kumquat has been tried and has proved satisfactory: Take four parts sugar and three parts water; place in a preserving kettle and boil for five minutes; select fresh fruit so as to have it of uniform size and

ripeness. Place the fruit in the boiling syrup and boil briskly for an hour and a half. Do not allow it to simmer or the rinds will become tough. Remove from the fire and seal at once. A pint of fruit, two cupfuls of sugar and a cupful and a half of water make about a quart.

Analyses.

The station chemists Messrs. Miller and Blair have found that the kumquats contain the percentages of fertilizer ingredients shown in the accompanying table. The averages, it may be noted agree very closely with the results of similar work done by them on pomelos. (See Bul. 58.)

VARIETY.	P ₂ O ₅ per cent.	K ₂ O per cent.	N per cent.
Marumi.....	.0528	.2623	.14
Nagami.....	.0531	.2796	.132
Average.....	.0529	.2709	.136

Twenty-four quarts of kumquats, the contents of one carrier, weighs forty-two pounds, or one and three-fourths pounds to the quart. Ten carriers would therefore weigh 420 pounds. This amount of fruit would remove from the soil .222 pounds phosphoric acid (P₂O₅), 1.137 pounds potash (K₂O), and .571 pounds nitrogen (N). Using dissolved bone analysing 18 per cent. phosphoric acid, high grade sulphate of potash, 50 per cent. potash and sulphate of ammonia analyzing 20 per cent. nitrogen, there would be required 1.233 pounds dissolved bone, and 2.274 pounds high grade sulphate of potash and 2.855 pounds sulphate of ammonia to replace the fertilizer removed from the soil.

H. HAROLD HUME.

BULLETIN NO. 66.

FEBRUARY, 1903.

FLORIDA
AGRICULTURAL EXPERIMENT STATION.

THE
MANDARIN ORANGE GROUP.



By H. HAROLD HUME.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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The Mandarin Orange Group.

Introductory Remarks.

Usually the different varieties of citrus are hard to differentiate; they are distinguished in the fruit by no well marked characteristics and even the trees show but slight differences in leafage and habit of growth. Moreover, the varieties differ with changes in soil, in moisture, in age, in fertilization and the many other things which affect the development of the tree. It is possible for the pomologist, after long acquaintance with varieties, to distinguish a considerable number with a fair degree of accuracy when grown under conditions which are constant. Let those conditions be changed and the task becomes a decidedly difficult one. But even when proficient in differentiating varieties, it is quite another matter to write descriptions for another's guidance. The distinctions are frequently so slight, so evanescent as to make the task perplexing indeed.

If the cultivated varieties of citrus fruits are ever to be classified with any degree of accuracy, they must be divided into groups of those varieties which most closely resemble one another, in which group some one variety, possessing the greatest number of characteristics common to the group, will constitute the *type*. No hard and fast lines can be drawn for the different groups, but in all cases the central figure, the *type* should, as already stated, possess a large number of characteristics of the group and should, as far as possible, at all times and under all conditions be easily recognized as distinct from all others.

The oranges under consideration, grown in Florida, are not difficult to distinguish either from each other or from the members of other groups. The *China mandarin* is taken as the type because it possesses a large number of characteristics common to the group and besides it has probably been longer in cultivation in America than any other member of the group.

Horicultural Status of the Mandarin Group.

At the present time three classes of citrus fruits are extensively cultivated in Florida, viz.: sweet oranges, pomelos and mandarin oranges. These occupy the first place in citrus culture in the State. Lemons, limes and kumquats are also grown. It is probable that lemon culture will become of considerable

more importance than it now is, but at present, and probably for some time to come, the statement, as made above, may be allowed to stand.

Of the three important classes, the sweet oranges occupy the first place and are destined to do so throughout the whole future of citrus culture in Florida. The sweet orange is a staple fruit, just as the apple is a staple fruit. It is always in demand, and it is the dessert fruit of America, *par excellence*.

The mandarin orange is essentially a fancy fruit and as such, commands a fancy price in its season, but it would be useless to attempt to place it on the same plane with the sweet orange as a staple fruit. The fruit, generally speaking, is smaller than the sweet orange. The bearing capacity of the tree seldom reaches and rarely exceeds twelve straps,* and all the members of the group require careful cultivation and fertilization to secure the best quality. Of course, this may be said of sweet oranges or any other citrus fruit, but it is peculiarly true of oranges of the mandarin group.

Mandarin orange culture is on a staple basis at the present time, and the number of trees may be conservatively increased. Plantings should not be made out of all proportion to the plantings of other citrus trees, and the object of every grower should be, not so much to increase the output, as to produce a fruit of high quality, else there is no room for the fruit on the market. A good mandarin orange is an excellent fruit, a poor one is worthless. It should be in all respects a fancy fruit. The ruling price during the past season has been from \$3.00 to \$5.50 per strap.*

There is another matter which must not be overlooked in considering the horticultural status of this group. At present

* A strap is equal to two half boxes, see Bulletin No. 63. Fla. Exp. Sta.

it contains the hardiest known, large fruited, edible variety of citrus, the Satsuma. This variety extends the culture of citrus fruits on a safe basis far into the more exposed sections of the country. In northern Florida it withstands frost well and a considerable amount of this fruit (four or five hundred straps) was shipped from the extreme northern portion of Florida last winter, the price realized being from \$4.00 to \$5.00 per strap. The tree is hardy, the fruit matures early and is very desirable for shipment during the months of October and November.

Origin, History and Introduction into America.

The investigations of De Candolle and others show that we are safe in concluding that the mandarin oranges had their origin in Cochinchina. From that center they have been carried into many portions of the world.

Several gaps occur in the history of these oranges, and yet it has been possible to trace it with a fair degree of accuracy. The first mention of an orange which is believed to belong to this group is in Sterbeek's *Citricultura* where it is mentioned as the "Muscat apple."* It is well within the limits of probability that some member or members of the group were known to Rumphius and indeed Lourerio, in his original description of *Citrus nobilis* in 1790, refers to this possibility. Referring to the same dates and cuts, Bonavia comes to the conclusion that the *Aurantium sinense* of Rumphius must be grouped with the *suntara* oranges of India. Having carefully read the description written by Rumphius, both in the original and as translated by Bonavia, and after comparing it with specimens of the Rangpur lime, grown by Reasoner Bros., by Bonavia said to be a *suntara* orange, I must say that any attempt to decide this question places one on exceedingly debatable ground.

In 1805 two varieties of mandarin oranges were introduced into England from Canton by Sir Abraham Hume and fruit produced from these trees was illustrated in 1817 (2) and 1824 (3). According to du Breuil (4), the mandarin orange was introduced into Europe (continental) about 1828. In the vicinity of Parma it was cultivated on a large

* Sterbeek, F. Van. *Citricultura*. 27. 1682.

(1). It is probable that the *suntara* oranges as well as those of the mandarin group can well be referred to *C. nobilis* Lour.

(2). Bot. Reg. 3: 211. 1817.

(3). Bot. Reposit. 9: 608. 1824.

(4). Hist. Cult. Orang. Risso & Poiteau. 49. 1872.

scale as early as 1842 and its culture in the county of Niza and the region surrounding Genoa dates back to 1848 or 1850. The conclusions reached by du Breuil are further substantiated by the fact that Gallezio appears not to have known this tree and Risso and Poiteau make no mention of it in the first edition of their work. Du Breuil states that in commerce a distinction was made between the mandarins of Parma and those of Spain, Algeria, Niza and the coast of Italy.

Bonavia says that the mandarin orange was probably introduced into India from Egypt with a collection of orange trees in 1847 (1) and that a second introduction was made by himself in 1863 (2). It is not improbable that the mandarin oranges found their way into Egypt from some one of the countries of southern Europe.

The China mandarin according to the best information which can be secured was brought to Louisiana by the Italian consul at New Orleans some time between 1840 and 1850. The first trees were planted on the grounds of the consulate at Algiers across the river from New Orleans (3). It has been impossible to obtain the name of the consul or the exact date (4). Shortly after, or about 1850, some one of the mandarin oranges was known to northern nurserymen, for Buist (5) in 1854 refers to one of them as a recent introduction, valuable for pot culture.

The introduction of the China mandarin from Louisiana into Florida is credited to Maj. Atway by the committee of the Florida Fruit Growers' Association and at the time their report was made the original tree was growing in the grove of Dr. Moragne at Palatka. The accidental substitution of one word for another in Stubbs and Morgan's bulletin "The Orange and Other Citrus Fruits" has twisted the phraseology as quoted by Moore, Reasoner and others to read "Tree of original variety introduced by Maj. Atway, of Bayou Sara, La." Since their

(1), (2). The Cultivated Orange of India and Ceylon. 56 and 231. 1888.

(3). This information was supplied by Mr. W. L. Reddick of Triumph, La. in a letter to the author dated April 30, 1902.

(4). The consular officers to New Orleans about this time were A. Garibaldi, Acting Consul General from Sardinia recognized March 22, 1832.

G. A. Barelli, Vice Consul from the two Sicilies recognized Oct. 26, 1836.

Thos. Barrett, Consul from the Pontifical States recognized Oct 7, 1841.

Carlo Giovanni Manson, Consul from Tuscany, recognized Feb. 18, 1846.

Chas. Joseph Daron, Consul from the Pontifical States, recognized Dec. 18, 1846.

Joseph Lanata, Consul from Sardinia, recognized Oct. 14, 1852.

This information was given the writer by Dr. E. W. Allen, Office Experiment Stations, U. S. D. A. in a letter dated May 14, 1902.

(5). Buist, R. American Flower-Garden Directory. 224. 1824.

bulletin was written in Louisiana, this reading conveys an erroneous idea.

It has not been possible to fix the date of introduction of the mandarin oranges into Florida but if the report of the Fruit Growers' Association is correct, it was of course subsequent to the Louisiana introduction and presumably some time after it. The origin and introduction of each of the mandarin oranges is given in the section on varieties.

Scientific and Common Names.

Many writers on citrus fruits have placed the mandarin oranges under the species, *Citrus Aurantium* Linn. Others have considered it a variety of that species while some, believing it possessed distinctive, specific characteristics have followed Lourerio and have referred it to his species *Citrus nobilis*. In this latter view the writer concurs, and after a careful study of the matter has placed the whole group under that species, the citation of which is as follows:

Citrus nobilis Lour. Fl. Coch. 466. 1790.

The group as represented in Florida is distinct in habit of growth and in fruit from *C. Aurantium*. It may shade off into the first named species but where such is the case any variety in question should be relegated to the group of which it possesses the greatest number of marked characteristics. In illustration of this,—in the writer's opinion Tangerona, classed with the mandarin group in the catalogue of the Florida State Horticultural Society and in Bul. 8, U.S. D. A., Div. Pomology, should be cut out of that group and placed with the sweet oranges where it doubtless belongs. It probably contains some traces of the mandarin strain but if the specimens which have been examined were true to name, and there is every reason to believe that they were, its affinities are decidedly with the sweet oranges.

The reasons for adopting the group-name Mandarin are, that it has been longer in use and is probably more widely

known than any other. Many have referred to the Tangierines as a group or sub-group distinct and separate from the Mandarins. There may be reasons of greater or less weight for this division, but in this publication the name Tangierine has been discarded in favor of the older name. No distinction can be made between the Mandarin and the Tangierine oranges so-called, more than can be made between any two distinct varieties of fruits in recognized pomological groups. Moreover, the fact must not be overlooked that in some of the world's citrus growing districts the two names are used interchangeably.*

Two explanations have been given for the name mandarin as applied to this group of oranges. It was given either because the fruit was regarded as the best of the citrus family, just as the Mandarin or grandee stood in social rank above his fellowmen, or because this orange was the fruit of the rich and therefore only within the reach of the nobility. The fact that the fruit is extensively cultivated in China and Japan and that it is there held in such high esteem leads to the belief that the first explanation is the more correct one.

One other name, "Kid-glove oranges," has been applied to the group. In explanation of the origin of this name the remarks of the late E. H. Hart* are self explanatory, "The term "kid-glove" orange as applied to *Citrus nobilis*, originally a joke of our facetious countryman, Colonel Dancy, of Orange Mills, was gravely accepted as a synonym by our first nomenclature committee, and like many another whimsical what-do-you-call-him, it struck where one more dignified would have glanced off."

*Hart, J. H., Annual Report, Roy. Bot. Gar. Trinidad. 1891. 19. 1891.

*Hart, E. H., in Proc. 22nd Ses. Am. Pom. Soc. 75-76, 1889.

Description of the Tree.

Tree small, fifteen feet or somewhat more in height, more or less thorny; bark brownish or streaked; branches upright or drooping; branchlets green or dark, round or angled, generally small and slender; leaves small, lanceolate or oval, slightly crenate, petioles small, wingless or with very slight flanges; flowers white, sweet scented; petals five; stamens slightly connected, eighteen to twenty in number; fruit oblate, compressed, varying in color from orange yellow to tomato red; rind loosely attached to the pulp; sections nine to fifteen, loosely connected; seeds usually top-shaped of medium size; cotyledons pistachi green¹; leaves and twigs peculiarly and characteristically scented. Native of Cochin China. Usually regarded as being somewhat harder than the sweet orange.²

Varieties of Mandarin Oranges.

The mandarin oranges at present cultivated in Florida number nine varieties. Of these, but six, viz.—China, Cleopatra, Dancy, King, Oneco, and Satsuma, are listed by nurserymen, and consequently it is difficult to secure trees of the other varieties. However, it may be plainly stated that the list just given contains, with one possible exception, all of any commercial importance, and this one, namely Beauty, might replace Cleopatra to good advantage. Two other varieties, Sprack and Traveler, at one time listed in the catalogue of the State Horticultural Society have to all practical intents and purposes disappeared from cultivation, and at present writing fruit of them cannot be secured. Many of the varieties listed by Reasoner*

(1). The seeds of King have the Cotyledous white.

(2). Du Breuil notes this fact, l. c.

*Reasoner, P. W., in report on Condition of Tropical and Semi-Tropical Fruits in the United States. Bul. U. S. D. A., Div. Pom. I: 72-74, 1887. Reprint 1891.

are not now obtainable. In California two varieties besides those grown in Florida are cultivated to some extent which might be useful in this State if found to be superior to those we have already. These are Kinneola and Stevens.

The varieties are arranged alphabetically. The measurements of the fruit are given in inches, the diameter from base to apex being given first, followed by the transverse diameter.

BEAUTY. *Beauty of Glen Retreat*.—Form oblate, decidedly flattened, sections showing through the rind; size medium, 2 1-8 inches x 2 15-16 inches, 2 3-16 inches x 2 13-16 inches; stem small and slender; apex flat or with a very slight depression; base slightly depressed and ridged about the calyx; color deep reddish orange, not so highly colored as Dancy, glossy; rind smooth, very thin, 1-16 of an inch or slightly more in thickness; oil cells flush with the surface, large, conspicuous, elliptical oval, or much flattened, frequently set in the pithy lining of the rind from which they may be detached easily; sections ten or more, clearly defined, regular; rag almost entirely lacking; flesh orange colored; juice sacks broad, blunt; pulp melting; juice plentiful, orange colored; flavor distinct, rich, vinous; acidity and sweetness well blended; seeds present, small, few, top-shaped; core small, open, 1-2 inch or less in diameter; season December and January.

Tree thornless, branches and branchlets slender and willowy; leaves small, resembling those of Dancy; petioles characteristically small and slender, 3-4 of an inch long.

The fruit of this variety is very heavy, and though it floats in water it sinks almost below the surface. The color while not possessing quite so much of the reddish tinge as Dancy is decidedly darker than China. In flavor it resembles Dancy

though it is distinct. Beauty is a variety well worthy of propagation and trial.

Specimens of fruit received from C. W. Butler, St. Petersburg, Fla., December 13, 1901. Mr. Butler received his buds of the variety from the Agricultural Department and Col. Brackett informed the author that it was introduced from Australia by the U. S. Dept. of Agr. in 1893. In a letter to the writer dated at Sydney, N.S. Wales, Aust., April 18, 1902, W. J. Allen, Government fruit expert for that colony, says: "This mandarin was raised by Mr. W. H. Parker within a few miles of Brisbane, (Queensland) Aust., and is, I believe, a seedling from either the Emperor or Scarlet mandarin. The original tree was raised some time in 1888 or 1889. The fruit is of good size, solid, with a beautiful, thin, tough rind, and carries well. It is usually a good cropper and proves a profitable variety to grow."

CHINA. *China Celestial, China Mandarin, Kid-glove, Tangerine, Willow Leaved* —Form oblate, compressed; size medium, 1 7-8 inches x 2 1-2 inches, 2 15-16 inches x 3 inches, usually about 2 inches x 2 9-16 inches; color dark orange, shiny; apex slightly scarred, depressed, depression very shallow and rather broad; base nearly smooth, somewhat necked or creased, the number of creases frequently corresponding with the number of sections; stem small; calyx small, set in a slight depression; rind smooth, generally marked with depressions, corresponding to the number of sections, 1-8 inch or less in thickness, very loosely attached; oil cells conspicuous, slightly depressed or flush with the surface; sections ten to thirteen, rather irregular in size, well defined; flesh coarse grained in appearance, orange in color; juice sacks short, broad and blunt; pulp melting; juice plentiful, colored; acidity and sweetness well combined; flavor vinous, peculiar and distinct (musky?); seeds fifteen to twenty-

five, brownish white, top-shaped, roundish, beaked, plump; core open, spongy, 3-4 inches in diameter; season November to December.

Tree very willowy in growth, almost thornless; leaves small, narrow, deep green; fruit usually borne singly at the tips of slender branches.

China is not so extensively cultivated in Florida as the variety Dancy. In Louisiana it predominated before the freeze, and New Orleans is one of the best markets. The fruit is frequently in good shape for the Thanksgiving trade.

Specimens received from Reasoner Bros., Oneco, Fla., F. D. Waite, Palmetto, Fla., W. E. Baker, Melrose, Fla., J. J. Haden, Cocoanut Grove, Fla., A. J. Pettigrew, Manatee, Fla., C. C. Shooter, Earleton, Fla., J. M. McClung, Dunnedin, Fla. Introduced into Louisiana from Italy between 1840 and 1850. From thence it is said to have been brought to Florida by Maj. Atway, date unknown to the author.

CLEOPATRA. *Spice Tangierine.*—Form oblate, flattened and irregular in circumference outline; size small, 1 3-16 inches x 1 3-4 inches, 1 1-4 inches x 2 1-8 inches; color dark orange red, not so bright as Dancy; stem slender, base flat, slightly depressed or sometimes slightly elevated, roughened about the calyx apex depressed, generally navel marked; rind rough or inclined to roughness, 1-8 inch or less in thickness, loosely attached, in very ripe specimens separating entirely from the pulp ball; oil cells small, numerous; sections fifteen, small; flesh orange colored, coarse grained; juice sacks typically broad and blunt; juice abundant, colored; flavor vinous, acidity and sweetness normal; quality good; seeds about twenty, small, top-shaped; pith small, open; season January and February.

Tree thornless, forming a dense top, upright but inclined

to be willowy; leaves small; fruits produced singly or in bunches. As an ornamental this variety is very beautiful, but as a commercial variety it is not worthy of cultivation.

Specimens received from Reasoner Bros., Oneco, Fla., and A. J. Pettigrew, Manatee, Fla. In Bulletin 1, U. S. D. A., Div. Pomology, Reasoner says that the Spice tangierine was introduced into Florida by Col. Codrington from Jamaica. Under the name Cleopatra it had been known for a long time in Florida.

DANCY. *Tangierine*, *Dancy's Tangierine*, *Bijou*, *Moragne's Tangierine*.—Form oblate, sections showing through the rind; size medium 1 3-4 inches x 2 5-8 inches, 2 1-8 inches x 3 1-16 inches; color deep orange red, almost tomato red, shiny; stem slender; base sometimes smooth, frequently nipped or more or less corrugated; calyx small, segments blunt pointed; apex terminating in a broad, shallow depression, sometimes scarred; rind smooth 1-16 inch to 1-8 inch thick, leathery, easily removed, attached by a few strings to the flesh; oil cells small, usually flush with the surface though sometimes slightly depressed; sections eleven to fourteen in number, fairly regular in size, easily detached from one another; flesh dark orange colored, coarse grained; juice sacks short, broad and blunt; juice abundant, colored; rag almost entirely absent; pulp melting, acidity and sweetness well blended; flavor rich and sprightly; quality excellent; pith open, 3-4 inches across; seeds seven to twenty, rather small, short and blunt or top-shaped and beaked; season December and January.

Tree compactly headed, rather upright though tending to spread as the head is opened from year to year by the weight of the fruit, densely foliaged, fruit exposed on the outer portion of the tree. Dancy has been more generally planted than any other variety of the group. Its high color combined with excel-

lent quality make it a particularly fine variety. It is commonly known throughout the State and in the markets as tangierine.

Specimens received from J. J. Haden, Cocoanut Grove, Fla., C. C. Shooter, Earleton, Fla., W. E. Baker, Melrose, Fla., Reasoner Bros., Oneco, Fla., John Thompson, Clear Water, Fla., F. D. Waite, Palmetto, Fla., A. J. Pettigrew, Manatee, Fla., J. M. McClung, Dunedin, Fla., C. T. McCarty, Ankona, Fla., G. L. Taber, Glen St. Mary, Fla., and C. W. Butler, St. Petersburg, Fla. The variety Dancy is said to have originated as a seedling¹ at Buena Vista, St. John's county, Fla. The parent tree was raised by Col. Geo. L. Dancy and was introduced into cultivation in 1871 or early in 1872.* It has proved to be a very prolific variety.

KING. *King of Siam* — (*Bul. Div. Pomology. U. S. D. A.* 1: 73, 1887). Form oblate; size large, 2 3-8 inches x 3 inches, 3 1-16 inches x 3 3-4 inches, 3 3-8 inches x 4 1-4 inches; color deep orange; base somewhat roughened and creased; apex flattened, scarred and very slightly depressed; calyx small, five pointed; rind rough, pitted, 1-8 to 1-4 inch thick, separating easily from the flesh; oil cells large, flush with the surface or slightly depressed, mostly balloon-shaped; sections thirteen, fairly regular, easily detached from one another; flesh rather coarse grained, orange in color; juice sacks spindle-shaped, not

(1). Reasoner says that Dancy is a seedling of China. I am inclined to doubt this for if such were the case it is not likely that it would prove so strongly prepotent as it is. Every seedling of Dancy observed bears a strong resemblance to the parent. Moreover, in a letter dated at Palatka, Fla., Jan. 1, 1903, Miss S. W. Moragne states that a tangierine tree was growing on her father's place when it was purchased about 1843, and further states that China was not the first of the group grown in Florida. Twigs of trees propagated from the original strongly resemble Dancy. The author believes that Dancy originated from this variety.

*This information regarding the date was given to the writer by G. L. Dancy, grandson of George L. Dancy, who originated the variety, in a letter dated at Jacksonville, Fla., July 25, 1902.

Plate I.



Dancy.



King.

8700

so broad and blunt as in other members of the group; juice abundant, colored; pulp melting; acidity and sweetness well blended, flavor agreeable, sprightly; quality very good; seeds eighteen to twenty in number, large, resembling those of the sweet oranges, cotyledons white; season late, March-April.

Tree stiff and upright in growth, generally thorny though some specimens have fewer thorns than others, foliage dark green, resembling that of the sweet oranges.

The King mandarin has been quite extensively planted in Florida, but, at the present time, does not appear to be held in quite as high estimation as it formerly was. The wood appears to be brittle and frequently the trees bear so heavily that they are almost stripped of their branches by the weight of fruit. This might be obviated by thinning. The fruit is much exposed to the sun and is frequently badly sunburned and rendered unsalable. On the other hand it must be stated in its favor that the variety is prolific, of good quality, and since it matures late in the season good prices are always secured.

Specimens of fruit received from T. J. Watkins, Nocatee, Fla., C. C. Shooter, Earleton, Fla., J. J. Haden, Cocoanut Grove, Fla., G. L. Taber, Glen St. Mary, Fla., Reasoner Bros., Oneco, Fla. Introduced into Florida in 1882 from California by Mr. John Carville Storin, of Winter Park, Fla. The variety was introduced into California from Cochin China in the same year by Dr. R. Magee, Riverside, Cal.

KINO KUNI. Form oblate, much flattened, size small to medium, 1 3-8 inches x 2 inches, 1 5-8 inches x 2 5-8 inches; color deep orange or orange red; stem slender; base usually creased or roughened with four or five ridges; calyx small, slightly depressed; apex ending in a broad, shallow depression nearly 3-16 inch deep; rind rather rough separating readily from the pulp, 1-8 inches or slightly less in thickness; oil cells conspicu-

ous, depressed; sections usually thirteen in number, irregular in size; flesh coarse grained, reddish orange in color; juice sacks short, broad, blunt; juice abundant, colored; pulp melting acidity and sweetness well blended; flavor sprightly; quality quite good; pith open; seeds thirteen to fourteen, top-shaped, beaked; cotyledons green; season November-December.

Tree compactly headed, resembling Cleopatra; leaves small; fruit of quite good quality but not of much commercial importance.

Specimens of fruit from John Thompson, Clear Water, Fla. Mr. Thompson obtained the variety from Mr. J. L. Normand, of Marksville, La. It is not known when it was first introduced into Florida, but at present a tree in the Thompson grove is the only one known to the writer. It is a Japanese variety.

MIKADO. Form oblate; size medium to large, 1 3-8 inches x 2 5-8 inches, 2 1-8 inches x 3 inches; color orange yellow; stem stout, base slightly depressed about the calyx, rough or corrugated; calyx small, sunken; apex terminated by a broad, shallow depression; rind slightly rough, 1-8 inch in thickness; oil cells large, occasionally 1-16 inch in diameter, conspicuous, slightly elevated or sometimes depressed; sections thirteen to fourteen, well defined, rather irregular, separating easily; flesh orange colored, coarse grained; juice sacks elongated, or broad and blunt; juice abundant, orange colored; pulp melting; acidity and sweetness well blended; flavor rich, sprightly; quality very good; pith open 3-4 inches across; seeds nine, top-shaped, distinctly beaked, large, 3-4 inches x 1-4 inches x 5-16 inches; cotyledons green; season October-November.

Tree inclined to be upright, in general resembling Satsuma, but not so reclinate; leaves with petioles generally distinctly flanged. As already noted this variety closely resembles Sat-

suma of which it is a seedling. It differs from Satsuma in its more upright habit, in having distinctly flanged leaves, in the larger and more conspicuous oil cells of the rind, in the shape and number of the seeds, and the larger, broader depression about the apex. It cannot, however, be considered as being in any wise superior to Satsuma.

Specimens from C. W. Butler, St. Petersburg, Fla. Originated by Rev. Lyman Phelps of Sanford, Fla.

ONECO. *Reasoner's catalogue*, 1900. Form oblate, flattened at the apex and tapering from about the middle to the base; size medium to large, 2 5-16 inches x 2 7-8 inches, 2 1-2 inches x 3 1-4 inches; color deep orange yellow; base slightly ridged or smooth; calyx very small; apex ending in a broad, shallow depression; rind 1-8 inch thick, generally inclined to be rough though frequently smooth, easily detached; oil cells large and conspicuous; sections twelve in number, fairly regular, clearly defined; flesh coarse grained, orange yellow in color, juice sacks broad, short; juice abundant, colored; rag absent; pulp melting; acidity and sweetness well blended; flavor distinct, rich, vinous; quality excellent; pith open; seeds small, twelve to fourteen, top-shaped, beaked; cotyledons green; season January-March.

Tree rather upright, foliage small with a pronounced fragrance when bruised; thorny but with many thornless branches. The fruit is excellent in flavor and is not surpassed in quality by any other variety of the mandarin group known to the writer. The flavor may be said to resemble a combination of Dancy, King and Satsuma.

Fruit received from Reasoner Bros., Oneco, Fla. This variety was raised from seed received from north-western India and planted by the late P. W. Reasoner in 1888.

The original seedling tree is still standing on the grounds of Reasoner Bros., at Oneco, Fla.

SATSUMA. (*Manville's Prac. Orange Cult.* 112. 1883.)—Form oblate; sections frequently showing through the rind; size variable, 1 7-8 inches x 2 5-8 inches and 2 5-8 inches x 3 7-16 inches representing the variation in size; color orange yellow; base usually slightly creased; calyx small; apex scarred with a round brownish spot situated in a broad, shallow depression; rind 1-8 inch thick, inclined to be rough; oil cells large, conspicuous, frequently depressed though sometimes flush with the surface; flesh coarse grained, deep orange in color; juice sacks short, broad; juice abundant, yellowish orange in color; pulp melting; acidity and sweetness well balanced; flavor sprightly, agreeable; quality excellent; pith open with the sections frequently separated at the inner edges; generally seedless though occasionally from one to four seeds are found, top-shaped, broad, plump, not distinctly beaked as in others of the group; season October-November.

Tree thornless and of spreading dwarf habit, branches reclinate, branchlets angled; leaves broad, tapering abruptly toward the apex, petioles scarcely margined. The leaves generally point upward and thus either follow the direction of the branches or are at right angles to them. The smaller fruits ripen first while the larger ones are later in maturing. The Satsuma is at its best just when it reaches maturity. In the extreme southern end of the State it does not color well but remains green or greenish for a considerable time after the juice has acquired its best flavor. The variety is very hardy in north Florida and is strongly recommended for planting in that portion of the State. The fruit is well received in the markets, the trees bear regularly a fair crop of fruit. Fruit and leaves

Plate II.



Oneco.



Satsuma

— 170 —

sometimes attacked and distorted by the attacks of scab caused by *Cladosporium elegans* Penzig? See plate 3, Bul. 53.

Specimens from John Thompson, Clear Water Harbor, Fla., C. B. Thornton, Orlando, Fla., J. B. Ellsworth, Jessamine, Fla., G. L. Taber, Glen St. Mary, Fla., and C. M. McClung, Dunedin, Fla. Satsuma is a Japanese variety. Two introductions were made from Japan in the 70's, one by Dr. Geo. R. Hall in 1876, the other by Mrs. VanValkenburg in 1878.

Estimation of Varieties.

In order of ripening the varieties are arranged as follows: Satsuma, China, Dancy, Oneco, King. The fruiting period of these five varieties extends through a period of six or seven months or from October to the last of April. It is impossible to place each variety in a definite ripening period because the locality and the treatment given the trees have much to do with the time of maturity. But some such general arrangement as this is a close approximation. Satsuma, October and November; China, November and December; Dancy, December and January; Oneco, January to March; King, February to April.

Satsuma, China and Dancy are well worthy of cultivation, but Satsuma is not recommended for planting in the extreme southern end of the State, and Dancy brings more money in most markets than China. Oneco is a variety of very fine quality, and if its bearing capacity equals its quality it will indeed prove a valuable acquisition. King has some excellent qualities and brings a good price in its season. It has, however, one or two objections as already noted. Cleopatra and Kino Kuni are worthy of cultivation only as ornamentals. Mikado is in no wise superior to Satsuma which it closely resembles and it is not nearly so seedless. Beauty, a variety of merit but un-

tried, is recommended for trial. It is one of the best varieties grown in Queensland, Australia.

Analyses.

Six varieties of Mandarin oranges have been analyzed for the Horticultural Dept. by Messrs. Miller & Blair, the Station Chemists. The results are given below. Some of the varieties have never been analyzed before and the determinations are of very considerable interest and importance giving, as they do, reliable information concerning the acid and sugar content of the different varieties and the amount of fertilizer constituents removed from the soil.

In each case a composite sample was taken from ten fruits. The Satsumas used in the analytical work were received from G. L. Taber, Glen St. Mary, Fla., who probably has the largest plantation of the variety in the state if not in the country. The other varieties were received from Reasoner Bros., Oneco, Fla.

Table No. 1.

Lab. No.	VARIETY.	Average weight in grams.	Average weight in ounces.	Average dimensions in inches.	Average No. of seeds.	Pulp per cent.	Rind per cent.	Seeds per cent.
1361	Satsuma	124.48	4.35	2.2x2.7	.00	76.2	23.8	.00
1364	China	141.87	4.96	2.3x2.7	.19	75.0	21.4	3.6
1365	Dancy	105.78	3.70	1.9x2.6	.14	79.4	18.6	2.0
1370	Oneco	181.27	6.34	2.4x3.	.16	73.4	24.6	2.0
1371	Clopatra	64.4	2.25	1.5x2.3	.18	58.4	37.3	4.3
1374	King	229.83	8.04	2.6x3.5		57.6	40.1	2.3

Table No. 1 gives the average weight of each variety in grams and ounces, the average dimension in inches, the average number of seeds, and the percentage of pulp, rind and seed. Satsuma, as already noted, is generally seedless, and though occasionally a few are found there were none in the sample. In percentage of pulp the varieties grade as follows: Dancy, Satsuma, China, Oneco, Cleopatra, and King. In this particular sample of King the rind was very thick. In percentage of rind it will be noticed that Dancy was very much lower than any of the others while in this respect Cleopatra and King ran very high. The percentage of seed in China and Cleopatra greatly exceeds that found in the other varieties, a fact amply borne out by the large number of seeds generally found in these varieties.

The flavor of oranges depends to a very considerable extent upon the proper blending of the acid and sugar in the juice. If a given fruit is to be of the best quality it must be quite acid before ripening. Then as the process of maturing progresses the acid is toned down and the sugar increases relatively until the highest degree of perfection is reached. Now, if a fruit is analyzed before this time the results may show an undue preponderance of acid, and, on the other hand, if it has passed the time when it is at its best it may not contain sufficient acid relatively.

Table No. 2.

Lab. No.	VARIETY.	Substance.	Acid per cent.	Succrose per cent.	Invert sugar per cent.	Total sugar per cent.
1361	Satsuma	Juice	1.019	4.06	3.74	7.80
1364	China	Juice	.838	3.90	3.59	7.49
1365	Dancy	Juice	.884	5.59	3.92	9.51
1370	Oneco	Juice	.807	5.69	3.79	9.48
1371	Cleopatra	Juice	1.564	3.96	3.24	7.20
1374	King	Juice	1.564	5.73	3.22	8.95

The acid and sugar content of the six varieties is given in table No. 2. Satsuma, Cleopatra and King had hardly reached perfection, while the others were at their best. Satsuma, however, was at its best for shipping as it tones down after picking. In acid content King and Cleopatra were identical; China, Dancy and Oneco were nearly the same, while Satsuma was above any one of the last three named. The succrose in Dancy, Oneco, and King was almost the same. The amount in China was 3.90 per cent. and in Cleopatra 3.96 per cent. Satsuma exceeded China by .16 per cent. The percentage of succrose shows a much wider range of variation than does the percentage of invert sugar. In total sugar content the varieties may be arranged as follows: Dancy, Oneco, King, Satsuma, China, Cleopatra. The general conclusion to be drawn from tables No. 1 and No. 2 is that of the whole six varieties analyzed Dancy was the best. It will not do, however, to generalize from the results of a single analysis. A number should be made in order to eliminate in as far as possible the differences due to cultivation, fertilization, etc. Still, as a matter of fact, the estima-

tion as shown in the tables of Dancy and Oneco coincides with the value usually placed upon them by competent judges.

Table No. 3.

VARIETY AND LAB. NO.	Substance.	K ₂ O per cent.	P ₂ O ₅ per cent.	N per cent.
Satsuma, 1361	Pulp	.1257	.0267	.0792
	Rind	.0864	.0119	.0869
	Seed			
China, 1364	Pulp	.1507	.0457	.0652
	Rind	.0826	.0178	.0404
	Seed	.0243	.0123	.0348
Dancy, 1365	Pulp	.1016	.0381	.0810
	.....	.1903	.0591	.1500
	Seed	.0127	.0061	.0236
Oneco, 1370	Pulp	.1674	.0345	.0763
	Rind	.0929	.0154	.0635
	Seed	.0129	.0074	.0255
Cleopatra, 1371	Pulp	.1711	.0274	.0631
	Rind	.1186	.0131	.0593
	Seed	.0302	.0124	.0415
King, 1374	Pulp	.1371	.0282	.0639
	Rind	.1263	.0192	.0653
	Seed	.0157	.0057	.0214

Table No. 3 shows the percentage of phosphoric acid (P₂O₅), potash (K₂O) and nitrogen (N) in the pulp, rind and seed of each of the six varieties. From this it may be noted that the largest percentage of phosphoric acid was contained in the pulp, that the rind contained less than the pulp and the seeds

still less than either of the other two parts. A close examination of the potash column shows the same results, and the same is true of the nitrogen except in Satsuma and King.

Table No. 4.

VARIETY AND LAB. NO.	K ₂ O total per cent.	P ₂ O ₅ total per cent.	N total per cent.
Satsuma, 1361..	.2121	.0386	.1661
China, 1364..	.2576	.0758	.1404
Dancy, 1365..	.1903	.0591	.1500
Oneco, 1370..	.2732	.0573	.1653
Cleopatra, 1371..	.3199	.0529	.1639
King, 1374..	.2791	.0531	.1506
Average..	.2570	.0561	.1560

Table No. 4 gives the total percentage of each of the three important fertilizer constituents in the six varieties. The phosphoric acid varies from .0386 per cent. in Satsuma to .0758 in China. The potash varies from .1903 per cent. in Dancy to .3199 per cent. in Cleopatra, and the nitrogen from .1404 per cent. in China to .1661 per cent. in Satsuma. The averages show .1561 per cent. phosphoric acid, .2570 per cent. potash and .1560 per cent. nitrogen. It is interesting to compare these averages with those given for pomelos on page 405 Bul. 58, and for kumquats on page 566 Bul. 65. Such comparison shows only a very slight variation in the average percentage of fertilizer ingredients contained in the different fruits.

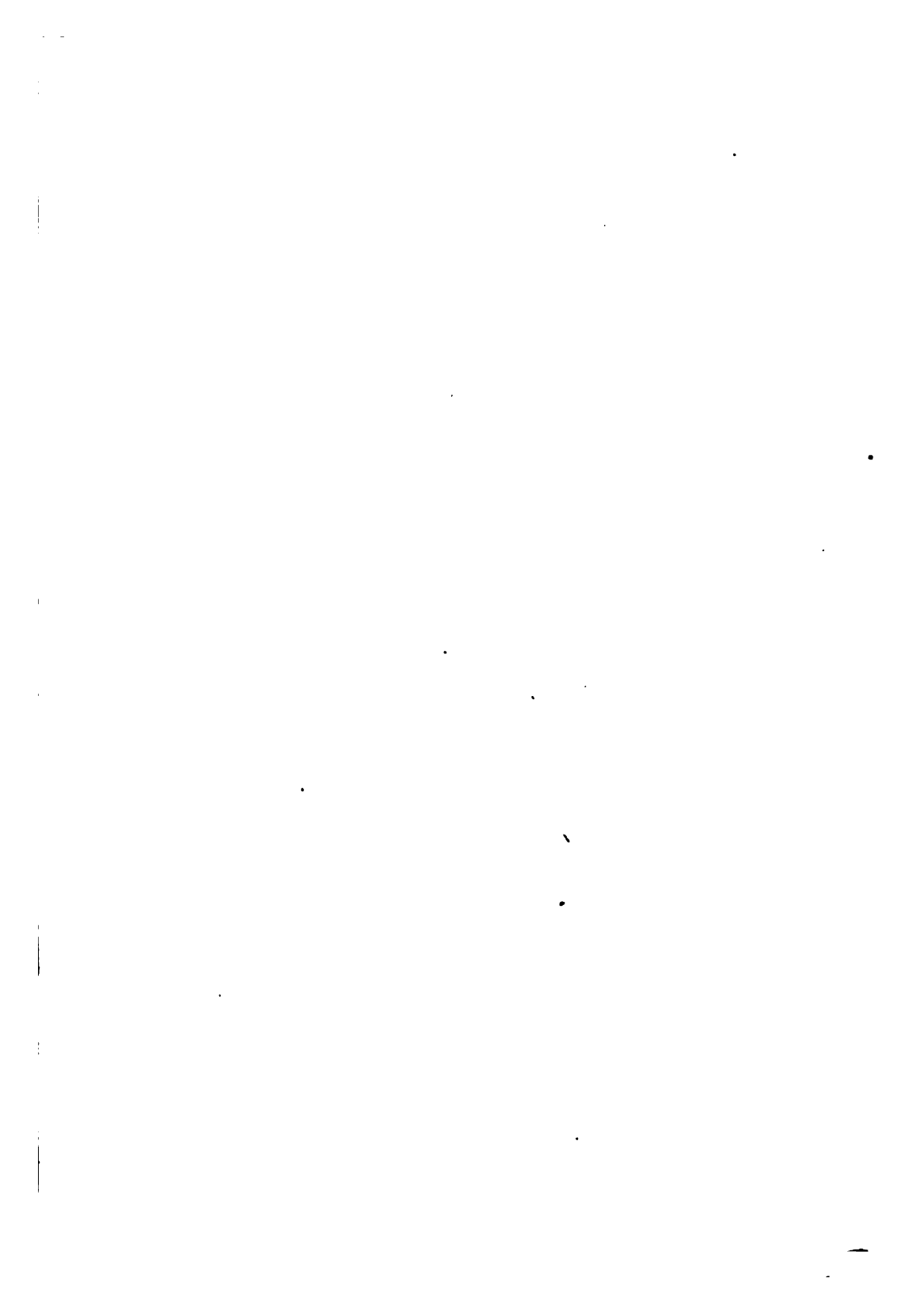
Assuming that five straps of mandarins will weigh 425 lbs. or 85 lbs. per strap, we can from table No. 4 determine the amount of fertilizer ingredients removed from the soil by that

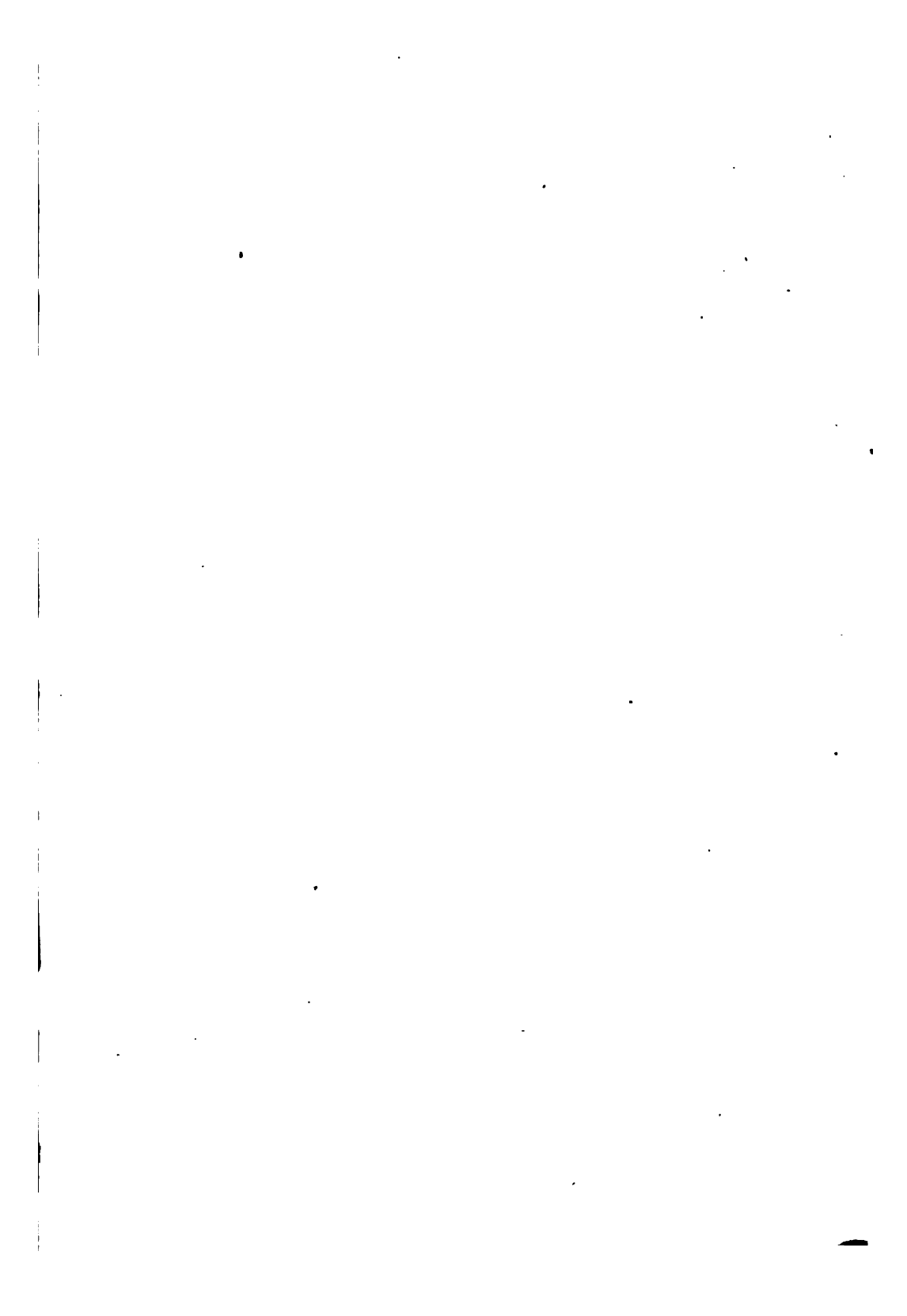
amount of fruit. There would be removed .239 lbs. of phosphoric acid, 1.192 lbs. of potash and .662 lbs. of nitrogen. These amounts must be supplied from the soil, as they are all taken into the tree through the roots. It is interesting to note that the quantity of potash removed is about one and one-fourth times the amount of phosphoric acid and nitrogen together. Furthermore, the amount of phosphoric acid is very much less than the quantity of nitrogen. Now, if we assume that dissolved bone analyzes 18 per cent. of phosphoric acid, acid phosphate 14 per cent. phosphoric acid, high grade sulphate of potash, 50 per cent. of potash, nitrate of soda 15 per cent. of nitrogen, sulphate of ammonia 20 per cent. of nitrogen, there would then be required 1.33 lbs. (1 lb. 5 1-4 ozs.) of dissolved bone, or 1.66 lbs. (1 lb. 10 1-2 ozs.) of acid phosphate to supply the amount of phosphoric acid removed, 2.384 lbs. (2 lbs. 6 1-4 ozs.) high grade sulphate of potash to supply the potash and 4.413 lbs. (4 lbs. 6 3-5 ozs.) nitrate of soda or 3.33 lbs. (3 lbs. 5 ozs.) sulphate of ammonia to supply the nitrogen. If we follow this still further and estimate the amounts of the different substances required to make a ton in different combinations we would have (1) 379 lbs dissolved bone, 679 lbs. high grade sulphate of potash, 942 lbs. sulphate of ammonia. (2) 327 lbs. dissolved bone, 587 lbs. high grade sulphate of potash, 1086 lbs. nitrate of soda. (3) 393 lbs. acid phosphate, 564 lbs. high grade sulphate of potash, and 1043 lbs. nitrate of soda. (4) 452 lbs. acid phosphate, 648 lbs. high grade sulphate of potash, 900 lbs. sulphate of ammonia.

Now, if we examine the percentage composition of the first of these combinations we find that it will contain about 3.4 per cent. P_2O_5 , 16 per cent. K_2O , and 9 per cent. N. A similar examination of the other formulae will give somewhat similar results. But it must be said that the use of such formulae is not

even advised and cannot be recommended without an actual test. They are simply given here to show that the usual belief that potash is required for fruit formation is not without foundation, and on the other hand it appears that smaller amounts of phosphoric acid are required than is generally supposed and that citrus trees draw heavily on the nitrogen content of the soil. The well informed grower knows whether his trees need nitrogen or not and generally believes that his trees are receiving only a certain known amount, but due allowance must be made for the nitrogen carried to the soil in the rain, collected by leguminous plants or obtained from other sources. On general principles it may be said that a fertilizer composed of the materials mentioned above and analyzing 8 per cent. phosphoric acid, 12 per cent. potash, and 3 per cent. of nitrogen, will meet the requirements of most soils in the citrus growing districts of the state.

H. HAROLD HUME.





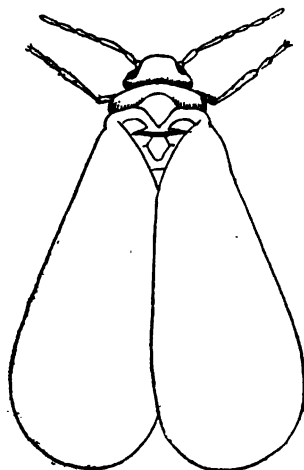
BULLETIN NO. 67.

JUNE, 1903.

FLORIDA
AGRICULTURAL EXPERIMENT STATION.

WHITE FLY.

(*Aleyrodes citri.*)



By H. A. GOSSARD.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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1903.

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The White Fly.

Aleyrodes citri Riley & Howard.

This insect first attracted the notice of entomologists in 1878, when it was observed in the orangery of the U. S. Dept. of Agriculture at Washington. Some observations were made upon its life history during that summer but no description of the insect was published until 1885 when Mr. W. H. Ashmead furnished a meagre description in the Florida Dispatch, Vol. XI, new series. The first adequate description was given by Riley & Howard in Insect Life, Vol. V, No. 4, issued in April, 1893. The name which Mr. Ashmead had bestowed, *Aleyrodes citri*, was retained by Riley & Howard, the insufficient description being discarded. The next important contribution to the literature of the insect was by Prof. H. J. Webber in an issue from the U. S. Division of Vegetable Physiology and Pathology in 1897. Prof. Webber's pamphlet was entitled Sooty Mold of the Orange and its Treatment; but it recognized sooty mold as a development resulting from white fly attack. Prof. Webber's recommendations pointed out the necessity for destroying the fly, it being the cause of the mold, and the article was a very important one because it first emphasized the efficacy of resin spray against the insect and also described the two fungous diseases that constitute the greatest natural checks upon its multiplication.

The most extensive work with hydrocyanic acid gas against the insect in the field was performed by the writer about two years ago, a summary of which was published in the annual report of the Experiment Station for the same year.

The Family Aleyrodidae.

The family Aleyrodidae, to which the white fly belongs, contains a large number of species, most of which are of little economic importance, usually being kept in good subjection by minute hymenopterous parasites. Among the exceptions to the general statement of harmlessness is a European species, *A. vaporariorum*, which has long been known as something of a pest in Europe; and in this country, relieved of its European parasites, it is all too fast getting the reputation of being a first-class pest in greenhouses and gardens. The white fly of the Melon Papaw (*Carica papaya*) *Aleyrodes variabilis* is also a pest that is not to be despised when on papaw; but owing to the restricted cultivation of its host it will not attract great attention unless it should prove its ability to multiply on other and important crops. The orange white fly, *Aleyrodes citri*, is the most destructive insect of the family. The family is characteristic of the tropics, but some species thrive out of doors in the northernmost parts of the United States. The immature insects are very scale-like, being closely related to the Coccidae or family of scales. The most conspicuous character separating the two families is that both sexes of adult Aleyrodidae possess two pairs of wings and can fly, while only the males of the Coccidae are motile and are possessed of a single pair of wings.

Origin and Distribution.

The original home of the white fly is not definitely known. Some entomologists incline to the belief that it is a native of Florida, others think it an importation. I submit at the conclusion of the bulletin an interesting contribution from Prof. T. D. A. Cockerell, who believes, from a comparative anatomical study of *A. citri* and many other species which he has collected from various parts of the world through many years, that our pest belongs to an Asiatic or Australasian group of white flies, and hence is not native. On the other hand, Prof. A. L.

Quaintance, who has made a specialty of the family, believes it quite probable that the insect is native, giving as his chief reason for so thinking that he has found it on *Viburnum nudum* and occasionally on *Quercus aquatica* in primeval hammock many miles from an orange grove; the conditions under which he has found it on the former plant in dense hammocks particularly emphasize to his judgment the possibility of its being indigenous to Florida. An instance of orange infestation which, I think, might be considered as sustaining Prof. Quaintance's view is found in the Manatee river section. The insect's first appearance in this district was in the Foster grove near Manatee. I am informed that not a bud or plant of any description was permitted to come upon this place from abroad for some years before the fly appeared. Did it migrate to the oranges from a native plant in the dense woods surrounding the grove? Or, did some one of the tens of thousands of migrating birds from the upper part of the State get some of the newly hatched insects entangled in its feathers and carry them to the Foster grove? Or again, might the calculating eye of a conscienceless competitor from upper Florida have feared the rich promise held out to the settlers in the Manatee region by the vigorous grove of Mr. Foster and have chosen to equalize the race between the respective sections by a malicious infection before the stress of competition was felt? Or what is, perhaps, more probable, is there some mistake about the report that no plants were introduced from abroad? However these questions may be answered, I incline to the view that the white fly is an imported insect. It is very unusual for an insect as vulnerable to parasitic attack as white fly to multiply in such excessive numbers. I have found *A. floridensis* on orange at Candler, but very sparsely, and the same insect has been sent to me from Arcadia. Such native species rarely become troublesome, it being well known that hymenopterous parasites usually keep them in subjection. The history and spread of *Aleyrodes vaporariorum*, a species known to have been imported, apparently exactly parallels that of *A. citri*. Few indeed are the insect enemies of the orange white fly; I have observed none

except lace-wing larvae and some mites and these scarcely deserve mention, they make so little impression on the insect. It may be possible to explain the spread of the fly as a native insect without its being accompanied by parasites by paralleling it with the Colorado potato beetle, a native insect originally feeding in restricted numbers upon a wild Solanaceous plant in Colorado and outstripping all of its enemies in a march to the Atlantic Seaboard as soon as the potato patches of the settlers furnished it with a suitable food plant outside of its original habitat; but if such were the case with white fly, would not some parasites ere this have made themselves known in some quarter of the infested territory? While Mr. Marlatt of the U. S. Dept. of Agriculture was in China and Japan hunting for the home of San Jose scale he collected some species of *Aleyrodes* but *A. citri* was not among them. Mr. E. Ernest Green has not collected *A. citri* in Ceylon, nor has Mr. H. W. Peal of Calcutta found it in Bengal. Mr. H. Maxwell Le-Froy, of the Imperial Dept. of Agriculture of the West Indies, has not found it in the West Indies, though another species of *Aleyrodes* is a pest upon the orange in Antigua. Importations of citrus plants have been made from time to time from China, Japan, and other parts of the East; and also thirty or forty years ago some large wholesale importations were made from Brazil, suggesting that it may have originated in the American tropics. Mr. Alexander Crow of the California State Board of Horticulture writes that he has received the insect upon plants from Chili where it is a great orange pest.

The fly seems to have been first known in Florida throughout the region comprised in Volusia, Marion, Lake, Alachua, and Orange counties from which, I have little or no doubt, it was transferred to the Manatee country and to local centers along the northern border of the State. Following the severe freezes during the years from 1895 to 1900 the insect was so thoroughly exterminated in the northern part of its range by successive defoliations due to cold that it was believed to be extinct throughout the section, and for all practical purposes was so. However, during the past two seasons there have been

indications of a revival in local spots, some of these, when upon oranges, being so conspicuously adjacent to hammocks as to suggest that the insects emerged from them. The nurseries, which for some years have furnished a supply of clean stock, are now becoming threatened and, while with proper care on the part of the nurserymen, I believe clean stock can yet be supplied for several years to come, the time is already here when the buyer must depend upon the representations and reliability of the respective nurserymen to guide him and not upon the inspections of the Entomologist. Certificates of freedom from the pest, correct when issued, may become untrue before their expiration, a year after being given; hence I can assume no further responsibility toward restricting its spread by inspection work.

In some of the southern counties it is found in a majority of the groves, but there is probably no county that does not possess many trees which are not yet infested. Manatee county is perhaps in the worst condition of any, at least 75 per cent. of the groves being infested. There are spots of infestation in Polk, Lee, Hillsboro, Marion, Putnam, Alachua, and Orange counties; it is also established at three or four points on the East Coast railroad in the counties of Duval, Volusia and Brevard; and in local spots in Baker, Columbia, Jefferson and Leon counties. It doubtless occurs at many places of which I have no record. I have no resources at my command to make a general inspection of the entire State, and correspondents sometimes seem disposed to conceal the fact that it is in their neighborhood. From information based upon its acknowledged distribution before the freeze of 1895 and letters on file in my office I conclude that a general and thorough State inspection would probably discover it in Lake, Osceola, DeSoto, Sumter and Pasco counties at least.

Outside of Florida the insect is recorded as either now being or having once been in Louisiana, Georgia, North Carolina, District of Columbia, and Texas. California newspaper reports sometime since indicated that some insect resembling *Aleyrodes citri* was present in the neighborhood of Los Angeles,

but the horticultural officers of that state seem to be confident that it is not present, and it is probable that with the thorough methods of warfare there employed, coupled with climatic influences, the insect would not attract much notice. The orange districts of Louisiana are quite generally infested, the insect probably having been introduced at the time of the New Orleans exposition in 1895. The white fly is often mentioned in connection with greenhouse infestation but here there may easily be confusion of specific identities.

Description.

THE EGG.—Very minute, about 1-125 of an inch (0.2mm) in length, being attached to the leaf by a slender stem or foot-stalk; about four times as long as thick, widest just beyond the middle towards the free end; color pale yellow, when first laid tinged with greenish, becoming darker as the embryo develops and some specimens becoming of a dark steel grey or blue. Surface smooth and shiny, often with clinging particles of white wax. Red eyes of embryo conspicuous through the shell as it approaches maturity.

LARVA.—Passes through four moults before reaching the pupa stage. When first hatched the insect is about 1-80 of an inch in length (0.3mm), of a pale greenish yellow color with two darker yellow spots on the back of the abdomen. There are four conspicuously long bristles at the posterior part of the body and six long ones on the anterior end with minute ones along the sides, each arising from a tubercle. Antennae, three or four jointed. Four eyes, dark reddish. Legs short, six in number. Mouth parts consist of a long, sucking tube. On the dorsal side of the last abdominal segment is a subovate, brown colored opening, the vasiform orifice. Appearance in second and third stage not markedly different from the first except in size and minute microscopical characters. In the fourth stage the length has increased to about 6-100 of an inch (1.5mm), the width to 4-100 of an inch (1mm) and the conspicuous bristles have vanished; a pair of persistent minute

bristles is found on the anterior border, one on each side, and another pair, also minute, is disposed one on each side of the anal cleft. The insect is very flat and close pressed to the leaf; the dorsum or back is crossed by twelve transverse ridges indicating the segments. Arising from the prothoracic region on each side, extending obliquely outward and forward to the margin is a distinct ridge or fold, the breathing fold. The outline of the developing wings of the embryo can be distinctly seen from the first.

PUPA.—To ordinary observation quite similar to the fourth larval stage but more plump and of thicker body; broadly oval. Measurements about as in fourth stage, slightly narrower. A broad, deep orange or coral-red spot on the back near anterior end of abdomen; eyes purplish; vasiform opening and ring brown; transverse ridges on abdomen shorter and less distinct than in last larval stage.

ADULT.—Female: Length slightly over 1-20 of an inch (1.4mm); wing expanse about twice the body's length (2.8mm); color light orange yellow; the rostrum or beak is tipped with black; the wings are colorless when newly hatched, but within two or three hours become covered with a fine white wax, hence, the name "mealy-wing" sometimes given to the insect. The body also becomes covered with more or less of wax but its ground color is not wholly obscured. Tarsi two-jointed. The eyes, reddish-brown in color, are each divided into two parts by a curved ridge projecting from the cheek, the upper divisions being the smaller. Ovipositor short, retractile.

ADULT.—Male: The male resembles the female but is smaller with the head and abdomen having heavier tufts of adhering wax. The abdomen is more slender and has at its termination a pair of claspers slightly curved upwards.

EXPLANATION OF PLATE I.

Aleyrodes citri.

- Fig. 1.—Adult female, with expanded wings, much enlarged.
Fig. 2.—Adult female, with wings folded over the body in normal roof-like position.
Fig. 3.—Egg and foot-stalk of same, greatly magnified.
Fig. 4.—Egg-shell, showing the split through which the larva emerged.
Fig. 5.—Tip of male abdomen, showing claspers.
Fig. 6.—Antenna, showing annulated joints.
Fig. 7.—Fore margin of front wing.

INSECTS SOMETIMES MISTAKEN FOR *A. citri*.

- Fig. 8.—Larva of *Aleyrodes floridensis* greatly magnified.
Fig. 10.—Greatly enlarged section of waxen fringe, surrounding *A. floridensis*.
Fig. 11.—Outline of larva of *Lecanium hesperidum*.

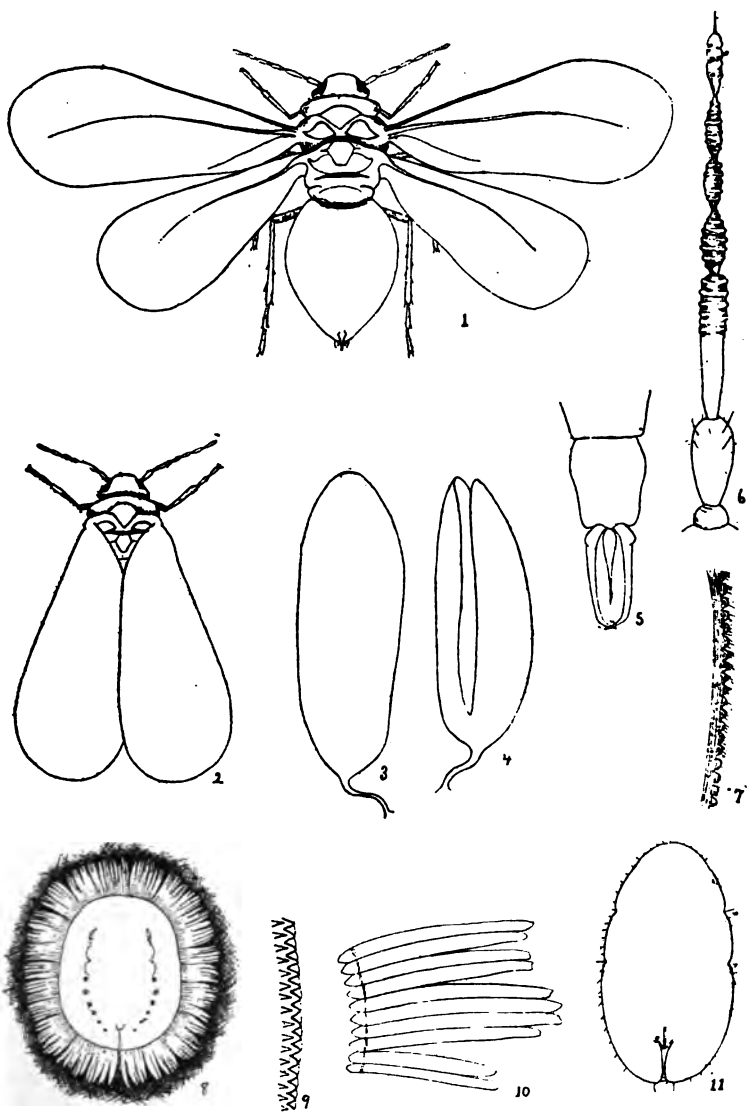
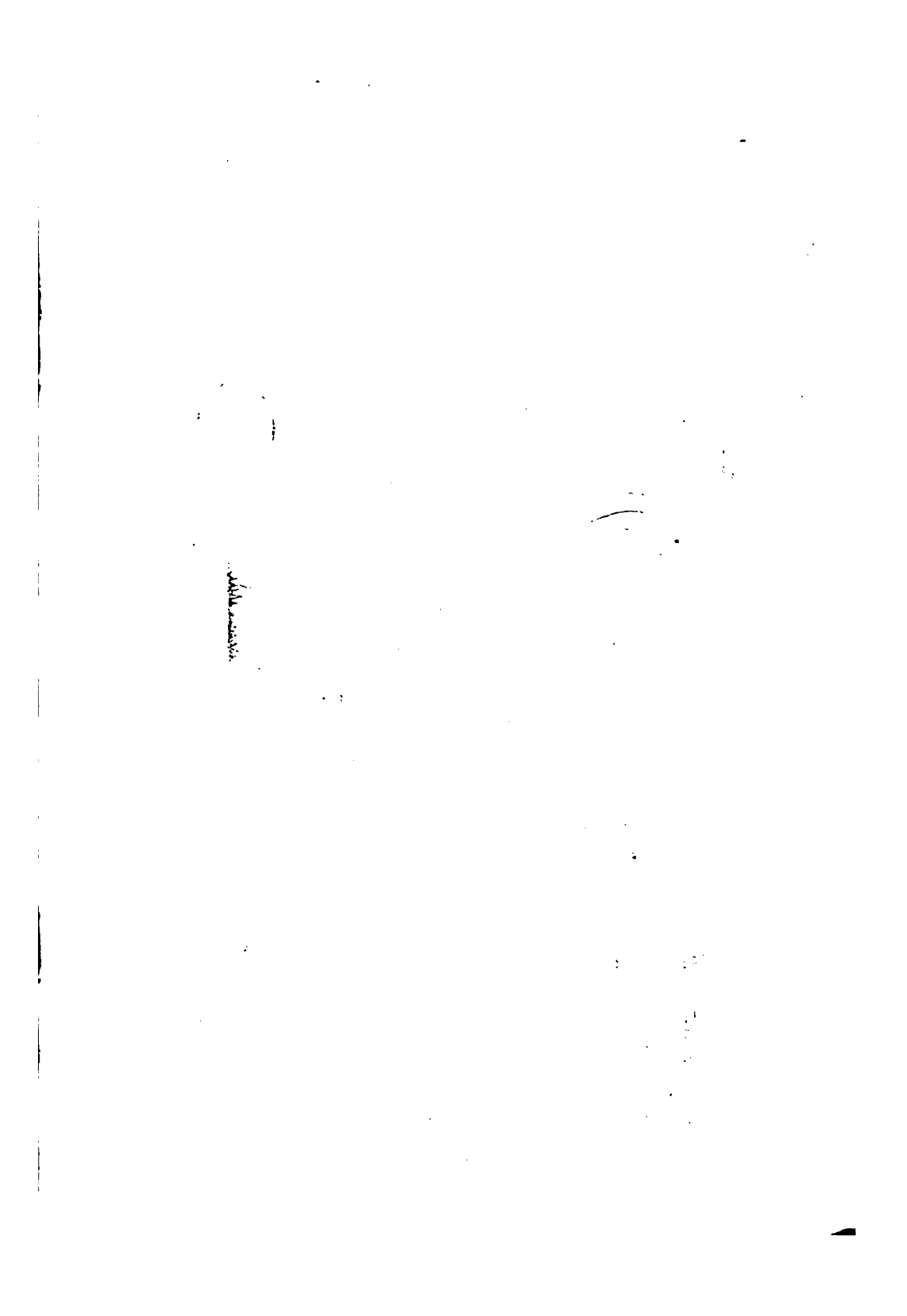


PLATE I.

1900



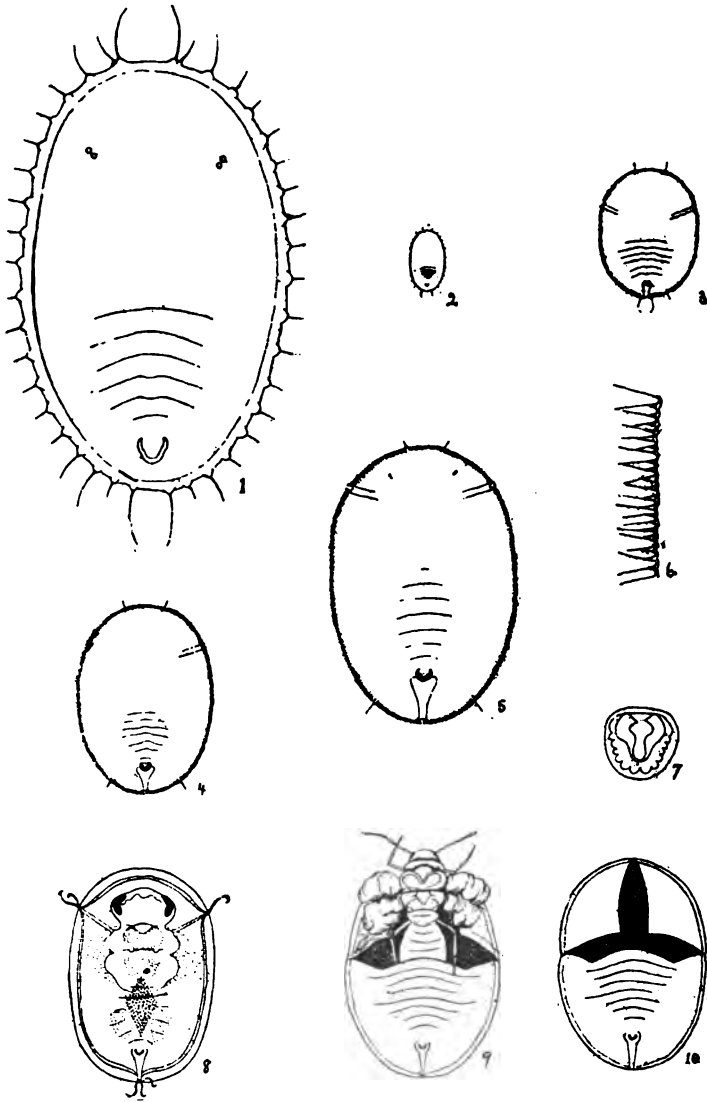


PLATE II.

EXPLANATION OF PLATE II.

Aleyrodes citri.

- Fig. 1.—Larva, first stage, greatly magnified.
Fig. 2.—Larva, first stage, drawn to same scale as figures 3, 4, 5, 8, 9, and 10.
Fig. 3.—Larva, second stage.
Fig. 4.—Larva, third stage.
Fig. 5.—Larva, fourth stage.
Fig. 6.—Margin of advanced larva, greatly enlarged.
Fig. 7.—Vasiform orifice of fourth larval stage, showing crenulated operculum with lingua in the center.
Fig. 8.—Pupa, showing embryo and distribution of orange colored areas. Waxed tufts extending from the breathing tubes are shown.
Fig. 9.—Adult, with folded wings, emerging from the pupa case.
Fig. 10.—Empty pupa case, showing split through which the fly emerged.

Life History and Habits.

FIRST BROOD OF ADULTS.—The first brood of adults issue during March, April and early May. The date varies with the season and locality. Localities not over a quarter of a mile from each other may exhibit a variation of two or three weeks, and particular spots or plants in an infested area may furnish an anticipation of the general appearance of the brood by a long interval. Thus, some sheltered lemon bushes at Ellenton, Fla., were observed by the writer to have produced adults on the 11th of February, though for the neighborhood at large the bulk of the brood issued during March and April. At Tampa, thirty to forty miles north of the Manatee section, the spring brood of flies has in some seasons preceded their appearance about Braidentown and Manatee by two weeks. Mr. A. J. Pettigrew, a close observer at Manatee, says that he once observed a few hatch about the 28th of January, and that he has twice seen them appear in considerable numbers in February, but that March hatches the bulk of the brood, most of them being on the wing before April 1st. At Lake City, last year, the few infested bushes about the town showed the first adults about the 14th of April and hatching continued until late May, most of them appearing during the last half of April. There was several days difference in the dates of appearance upon the different bushes. The present year found some of the adults on the wing at Lake City March 12, and they were reported on the wing at Orlando and at Palmetto on the 6th of March. At Lake City only a few stragglers were observed after the middle of April. Speaking of the entire district in which the insect can exist from South Florida to Georgia, the bulk of the first brood may be said to appear during March and April, with the adults which have hibernated as half-grown larvae straggling along into May and June. Only in the northern section will they ever linger as late as June. The adults live from three or four days to three weeks, the average period being from four to seven days.

The adults love close-planted, sheltered groves into which

the winds enter with difficulty. Consequently, the insect never becomes so numerous in well spaced, open groves on high pine land as in thick-planted, unpruned groves on hammock land surrounded by thick woods.

PAIRING AND EGG-LAYING.—The courtship of white fly, as observed with a pair in confinement, is quite curious. The male showed evidence of having detected the presence of the unimpregnated female at a distance of one-fourth of an inch or more, and approached her nervously, stopping at intervals, especially as the distance was lessened, and swinging his body about excitedly in a semi-circle, the head being used as a pivot, his wings in the meanwhile opening and closing spasmodically. While no movement was made by the female, several retreats were made and she was repeatedly approached from many directions before coition occurred. Upon the trees the males and females rest side by side and two males, one on either side, may often be seen giving their attentions to the same female.

Egg-laying begins within eighteen to thirty hours after the adults issue when the weather is warm, (sixty-five to seventy-five degrees) but with damp, cool weather several days may elapse before they are deposited. Egg deposition occurs upon the under surface of the leaves, preferably upon new ones, especially those of water sprouts, but old leaves may also be well covered with them; they are usually scattered over the surface of the leaf without much order of arrangement but sometimes are laid in the arc of a circle. From four to ten eggs may be observed in such an arc and are so placed by the female using her beak as a pivot around which the body is swung during oviposition. The eggs are not as numerous, ordinarily, near the edge of the leaf as further inward. Each female deposits from seventeen to twenty-five eggs in breeding cages, the rate of laying doubtless being governed by temperature. With the thermometer at 70 degrees to 76 degrees F. for several hours on each of two successive days the eggs were all laid within twenty-four hours after the first one was deposited and

the females under observation died soon after they stopped laying.

By mathematical computation a leaf from young orange, five inches long and two and one-half inches wide in the middle, collected at Myers, June 22, 1901, had upon it upwards of 20,000 eggs. While so many eggs upon such a space is beyond the average, it is by no means rare, and I have sometimes seen the number exceeded.

Hatching occurs in from three to twenty days according to the weather. In the summer season when the temperature maintains itself at from 80 degrees to 95 degrees for several days together the eggs hatch in three or four days. Hatching throughout the summer is very regular, comparatively speaking, the range probably being from three to eight days, while in spring and fall with temperature ranging from 50 degrees to 70 degrees from two to three weeks is required. The egg becomes of a metallic bluish-grey color as the embryo matures and splits longitudinally for a short distance down both sides at the distal end to give exit for the young larva.

LARVAL HISTORY AND HABITS.—The young larva is motile and crawls about over the leaves and twigs for several hours like a young scale before it attaches itself to the leaf. The first molt occurs in from seven to twenty-five days according to the temperature. In moulting, the larva bends the abdomen upward at a right angle to the leaf surface and with slow, struggling movement alternately raises and lowers it, the body meanwhile shrinking from the interior of the skin, causing the dorsal ridge to become distinctly elevated. The skin now splits at the anterior end or beneath the head and by abdominal wriggling the insect gradually pushes it off. The cast skin is very thin and fragile and is blown away by the wind or drops to the ground, seldom remaining long upon the leaf. The periods between all the moults seem to be determined by temperature and the fifth or pupal molt occurs in from twenty to thirty days after hatching during July and August but requires from four to five months during the winter. Add from ten to thirty days as the pupal stage and the life cycle from egg to adult is

seen to range from forty or fifty days to six months. When the insect is ready to emerge from the pupa shell, the skin splits in the form of a cross beginning at the head of the larva and extending along the middle of the back to the front of the abdomen where it bisects at right angles a transverse slit extending to the margin on either side. The thorax of the fly comes out first, followed by the head. The wings are much folded and colorless when first exposed; the insect at once elevates them into a vertical position to dry, and in about fifteen minutes they are expanded and lowered to a horizontal position; in ten minutes more they are in their normal roof-like position over the back; about two hours elapse before they lose their transparency and commence to whiten, and five or six hours pass before the typical powdery white appearance is reached.

The larvae attach themselves to the under sides of the leaves and are inconspicuous because of their transparency and greenish tinge. If the leaf be so doubled in the hand that air is admitted beneath the insect, it at once becomes readily seen and is translucent whitish green, spotted with orange. When infestation is so excessive that the larvae overlap each other, many of those that are beneath do not succeed in emerging, especially if the head of the larva is the part covered. So far as observed by the writer the larvae do not settle and feed elsewhere than upon the leaves. While some reliable observers report having found them attached to twigs and in buds, the most diligent search has never revealed to me a single specimen so located. Is it possible that the immature stages of one of the *Lecaniums* (possibly *hesperidum*) have been mistaken for white fly by the observers mentioned?

Seen best from the ventral side of the larva but also visible through the transparent dorsal surface, along the median line and slightly forward of a line connecting the inner points of the breathing folds, is a pulsating organ connected with the circulation which beats from one hundred-twenty to one hundred-fifty times per minute. Along the back of the abdomen the slow pulsations of the heart proper, a long muscular tube, can often be observed with a fairly good microscope. Absence of visible

movement in these organs may not be interpreted as perfect proof of death but they often furnish positive proof when death has not occurred and thus are a valuable means of observation to determine what has been the effect of insecticidal treatment.

SUMMER AND FALL BROODS.—During June and July the second brood of adults are on the wing in the southern part of the State, appearing about two weeks later in the latitude of Lake City. At the latter place last summer they commenced appearing about the first of July and were still abundant on the 12th of August. From this time onward there was no date until the middle of November when every stage of white fly from egg to adult could not be found in the neighborhood; not always every stage upon the same bush but persistent search was sure to find it within a half mile. September seemed to bring the greatest number of adults, which, with early October, may be regarded as the maturing time for the third brood. This year the second brood commenced hatching at Lake City, during the first week in June, and were reported to be hatched and in full swarm at Micanopy at the same time. The second brood, like the first, seems to be a month earlier this year than last.

While three generations a year seems to be the rule, there is a tendency to continuous breeding as some adults were observed upon privet at Lake City on Christmas day, and Prof. H. A. Morgan has likewise observed that it issues upon warm winter days in Louisiana. Four generations a year doubtless occur often, but not in sufficient numbers to obscure three well defined broods as the rule. Mr. Pettigrew sums up the history of the adult as follows for Manatee: "The spring brood is in sight from three to four weeks, then none are visible for three or four weeks; the second crop is in sight four to five weeks with one or two weeks following without any, after which the broods run together so there is only a thick and a thin streak. Sometimes the eggs for the winter brood of larvae are all deposited in October and at other times nearly all in November."

All the eggs of the winter brood are hatched before Christ-

mas. By March 1st a few of the insects are pupae and there are none that have not reached the third stage. The rapid development of the belated larvae during the warm days of March and April enable them to issue as adults within a month after the first flies of the brood appear, so the first brood is well defined each year. Something like ten to fifteen per cent. of the winter brood die, before spring, at Lake City, from no very definite cause.

Methods of Dissemination.

The insect is not a strong flyer but can go considerable distances with the wind, and infected neighborhoods often furnish unmistakable examples of the influence of prevailing winds in scattering it. The flies are often found in clouds upon weeds and herbage by roadsides and covered vehicles may collect some of them under such circumstances and transport them to considerable distances. They have also been observed upon windows in railway coaches, indicating that they can be carried long distances in this way.

I have stood beneath a tree upon which adults were plentiful and had them alight upon my clothing; I have then walked nearly a half mile against a stiff breeze and picked the flies from me by the dozen at the termination of my journey. They cling tenaciously to their support in a stiff wind but take flight quickly in quiet air.

When newly hatched they crawl about like young scales and may be caught in the hair of horses brushing against the trees, or in the feathers of birds and be thus transported from one grove to another.

During the months from July to December young larvae as well as adults are apt to be present in small numbers, at least, without intermission in an infested grove. Pickers, teams, ladders, baskets, etc., going from an infested grove to a clean one during this time can become the means of transporting the pest as well as when the spring brood is hatching and flying. Infested nursery stock is most apt to carry the insect into new localities.

Effects of Cold.

The larvae can stand more cold than the orange. I have, in repeated instances, taken larvae from leaves that had fallen to the ground because of cold ranging from 22 degrees to 17 degrees above zero, ten days to two weeks after the cold occurred and found by microscopic examination that the pulse was beating regular and strong. If infested leaves drop in early winter the larvae doubtless perish as they invariably die upon detached drying leaves in the laboratory in from nine to fourteen days, but with leaves dropped in February and lying upon moist earth it is conceivable that some of the insects may mature and issue. It seems certain that white fly will eventually range as far north as the hardiest orange. It will also be able to perpetuate itself upon the more hardy of its food plants, despite freezes that kill oranges to the ground.

To determine the degree of sudden cold which the insects can survive, Mr. A. O. Mann of the Lake City Ice Factory gave me the freedom of his factory for experimental purposes and sunk an empty can into the brine for my use. The temperature of the brine ranged from 10 degrees to 20 degrees, and the thermometers kept suspended in the can recorded temperatures as shown in the table. Twigs of orange and Cape jessamine, having upon them well matured pupae of the fly were used April 12th and 14th as follows:

	Time in Can	Temperature readings in can taken at intervals.	Result
Experiment No. 1.....	30 min.	14 degrees, 15 de, 15 de.	A few survived and issued as adults the next day.
Experiment No. 2.....	1 hr.	12 de., 14 de., 15 de., 15 de., 12 de., 14 de.	All killed.

In the following experiments the pupae were prepared for the extreme temperatures by first being put in cold storage. The temperature in the cold storage room was from 48 degrees to 50 degrees. Pupae left in this temperature for 48 hours were apparently uninjured and adults continued to issue in the

cold storage room; but if any significance at all can be attached to the cold storage preparation it weakens the resisting power of the insects at this date as shown in the following experiments:

	Time in Cold Storage	Time in can	Temperature readings, by degrees, in cans.	Result.
Experiment No. 8	1 hr. 45 min.	30 min.	12, 14, 15.	Two flies issued, remainder killed.
Experiment No. 4	48 hrs.	30 min.	25, 20, 20, 18.	All killed.
Experiment No. 5	1 hr. 45 min.	1 hr.	12, 14, 15, 12.	All killed.
Experiment No. 6	1 hr. 45 min.	2 hrs.	12, 14, 15, 15, 12, 10.	All killed.
Experiment No. 7	48 hrs.	2 hrs. 30 min.	20, 20, 14, 12, 10.	All killed.

It is quite probable that had the experiment been performed during the winter months with larvae that had become accustomed to cold there would have been a larger percentage of surviving insects. Temperatures as low as those used are never reached in South Florida and seldom last for more than a few minutes in North Florida; and when reached in a given district there are always sheltered spots in which the mercury does not fall so low. At various points along the line of the Seaboard Air Line R. R. from Jacksonville to Tallahassee the mercury has at different times, during the past ten years, descended to 6 degrees and 10 degrees. The fly, after such freezes, has disappeared from sight for a time but has invariably reappeared showing its ability to withstand the most extreme cold that occurs in this latitude. However, it is apparent that a deciduous orange adapted to North Florida and Georgia would not suffer much from the fly.

Mr. A. J. Mitchell, Section Director of the Florida Weather Service furnishes the following records for lowest temperatures at three points near the northern boundary:

JACKSONVILLE	LAKE CITY	TALLAHASSEE
14 degrees, Feb. 8, 1895.	15 degrees, Feb. 8, 1895.	11 degrees, Feb. 8, 1895.
14 degrees, Dec. 29, 1894.	16 degrees, Feb. 18, 1900.	12 degrees, Dec. 29, 1894.
10 degrees, Feb. 13, 1899.	6 degrees, Feb. 13, 1899.	-2 degrees, Feb. 13, 1899.

About two years after the 1899 freeze the insect was again observed at Lake City. It was reported from Jacksonville at about the same time.

State Chemist R. E. Rose informs me that the insect is present in considerable numbers at Tallahassee, and my office records show that it was present there before 1895.

Food Plants.

White fly occurs upon all varieties of citrus. *C. trifoliata* is, of course, only infested during the summer months, being a deciduous variety. The deciduous character of some of the *C. trifoliata* hybrids will tend to retard the multiplication of the pest upon them. The kumquat is still less a favorite than the pomelo, and the latter, though often badly infested, is usually attacked only after the adjacent oranges are overstocked. The adult flies as well as the larvae sap the leaves and their taste for certain varieties leads them to oviposit on these when possible, going to less favored plants only as they are driven by necessity to do so. Besides citrus, the Chinaberry tree (*Melia azederach*) and *Viburnum nudum* the Cape jessamine (*Gardenia florida*), the Japan persimmon (*Diospyros kaki*), California privet (*Ligustrum amurense*), Golden privet (*Ligustrum sp.*) and Mock Orange (*Prunus Caroliniana*) are food plants. Various species of *Ficus* are said to be food plants; I have seen it on two species, *F. altissima*, and on an unknown species introduced from Costa Rica.

The water oak (*Quercus aquatica*) is occasionally infested, according to Quaintance, and I have taken two or three larvae advanced to third and fourth stage on scrub palmetto. Their presence upon the latter plant is very rare having been observed but once, though opportunities have been plentiful.

Prickly ash (*Xanthoxylum sp.*) is reported as a food plant upon what I consider to be reliable authority, but I have not personally seen the insect upon any one of the three species found in this State.

Character of Injury. Sooty Mold.

The injury caused by white fly is not as threatening to the life of the tree as that caused by scale insects. The latter kill branches and sometimes entire trees with great rapidity when associated with other ailments, but their destruction by the former is comparatively slow. White fly certainly does often kill branches and sometimes trees, but rarely does a tree die from its attack alone. Footrot, dieback, and kindred troubles are the usual accompaniments of white fly when death occurs. As an illustration of the resisting powers of the orange to its attacks, the Foster grove may be cited, the one before mentioned as being the first case of infestation on the West Coast. This grove is referred to in some of the earliest literature of white fly (Insect Life) and has been infested for more than ten years; with the exception of a few trees, it is still living and looks as if it can keep up the struggle indefinitely. When seen by me about eighteen months ago the interior branches of most of the trees had a color, thrift and vigor not found in some groves wholly free from this insect. Except that the bearing capacity of the grove has been reduced, it may still be called one of the most valuable in the State. I was told by parties acquainted with its recent history that it bears a good crop about once in three years followed by two comparatively light crops. It was hardly carrying more fruit than would pay for the cost of maintenance at the time of my inspection of it. Seedling groves are inclined to alternate heavy with light crops so one of the light crops is accounted for, but the other is doubtless due to the fly. I believe any practical grower will think me well within the bounds of truth in saying that, through a six-year period, the yield with white fly present will be from twenty-five to forty per cent. less than it would be with the insect absent. Manatee county alone produces 250,000 boxes of fruit per year and thirty per cent. increase would be 75,000 boxes which, valued at \$2.50 per box, would amount to \$187,500. This is not far from the actual loss, as most of the groves in this county are infested. When the loss

in other districts and the indirect losses due to impaired quality and diminished carrying power are added, the State must receive nearly a half million dollars less annually than she would if the insects were absent. The acid and sugar content of the fruit is much reduced, an orange from a white fly tree being comparatively tasteless and insipid.

The following table shows the results of a chemical analysis made at my request by Profs. Miller and Blair of three lots of fruit picked the same day from adjoining Dancy tangierine groves, both of which were infested with white fly and had been given practically the same treatment as regards cultivation and fertilizing. Fifteen or twenty oranges were selected for each of three lots, representing as accurately as possible the average condition as to size and maturity on each of the three trees from which they were taken.

Sample No. 1 was from a tree that had been infested for several years and had been left to take care of itself.

Sample No. 2 was from a tree about forty feet from No. 1, and was regularly and properly sprayed three or four times each year but stood in the row adjoining the unsprayed grove and the insects could not be prevented from developing upon it in numbers sufficient to cause more or less mold.

Sample No. 3 was from a tree about 80 feet from No. 1, which was properly sprayed as was No. 2, but with better results. A few larvae were present on the leaves, but, practically, white fly could be considered wholly absent.

	Reducing Sugar, Per Cent.	Total Sugar Dextrose, Per Cent.	Citric Acid, Per Cent.
Sample No. 1	2.18	6.71	.425
Sample No. 2	2.23	6.26	.394
Sample No. 3	2.58	7.91	.445

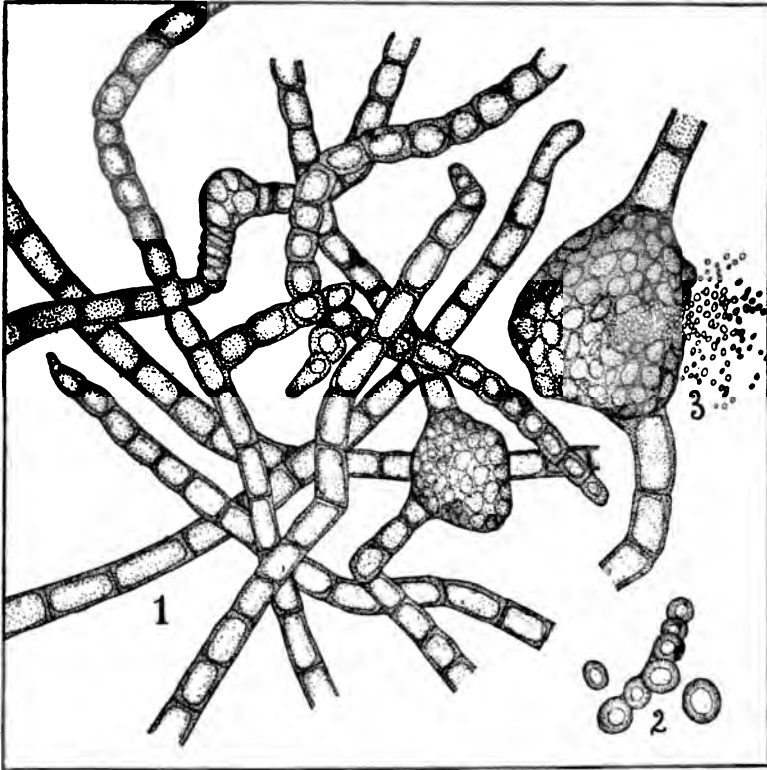
These samples were collected in February after they had passed their best, but it is believed that they kept their relative quality.

A liberal use of fertilizer tends to keep up the quality but the sooty mold upon the rind must be removed by hand-washing, by revolution in barrels filled with water and cross-cut sawdust or by suitable machinery provided with revolving brushes, and the consequent bruising of the rind invites quick decay which often occurs in transit.

The subtraction of so much sap from the tree by the insects, aided by the interference with assimilation caused by sooty mold, delays ripening of the fruit, varieties which ought to be at their prime by the first of December not being marketable before Christmas time and often not until three or four weeks thereafter.

The sooty mold is a black, saprophytic fungus, *Meliola Camelliae* (Call.) Sacc., that grows in the honey dew excreted by various insects. Among the Coccidae or scale insects which it follows, may be mentioned the various Lecaniums, the mealy bugs, the wax scales, *Icerya purchasi*, and others. The plant lice, or various species of *Aphis*, are also followed by it as well as all forms of Aleyrodidae which multiply excessively. Any insect excreting honey dew in any quantity is certain to be accompanied by the mold. Sooty trees and plants, therefore, are not always infested by white fly, though such an appearance upon any of the insect's food plants should receive an immediate investigation. The white fly larvae being located on the under sides of the leaves, the honey dew drops upon the upper surface of the leaves growing just below, so the black mold occurs chiefly upon the upper surface of the foliage and fruit. It forms a close, smothering, membranous covering that can sometimes be peeled back as if it were tissue paper. This membrane is composed of the netted mycelial threads of the fungus which reproduces by means of various reproductive bodies some of which are shown in cut No. 1, from Prof. Hume's bulletin on Citrus Troubles. The wind is the chief agent in disseminating the reproductive bodies. The effect which a heavy coating of this fungus produces upon a tree differs only in degree from what would be produced by enclosing it in a black tent. The circulation of air through the tree and entrance

of light is not interfered with, but contact of air and light with the foliage is cut off on the upper surface and partially also from the lower surface. The sooty mold is one of the most aggravating factors of white fly damage. It disappears with the destruction of the fly.



Cut 1—Sooty mold (greatly enlarged). 1. Mycelium or fungal threads; 2. Conidia; 3. Pycnidia with immature spores. (Drawing by Miss L. McCulloch.)

Natural Enemies.

The young of the lace-winged flies and a mite are the only insects that I have observed feeding upon the eggs or larvae. Lady-bugs possibly feed upon them to a slight degree but I have never observed them doing so. A correspondent at Kissimmee

reports that a carnivorous ant is quite efficient as a destroyer of the larvae. I cannot say that any of these appreciably reduce the insect, even locally.

Through the kindness of Mr. Ehrhorn of California, some hymenopterous parasites upon another species of *Aleyrodes* were sent to me and enclosed on an infested tree beneath a cheese-cloth tent, but several weeks later a freeze dropped all the leaves from the tree and only a negative result could occur. Further experiments of a similar nature are desirable, but too much must not be hoped from them. The parasites of many other Aleyrodidae in the State seem to have no taste for *A. citri*.

Fungous Diseases.

If insect enemies are ineffective, the same cannot be said of fungus diseases. Three species of fungi are known to find their natural medium for growth in the white fly larvae, and two of them are sometimes wonderfully successful, in certain localities, in reducing the pest.

BROWN FUNGUS.—First in order of effectiveness must be named the brown fungus whose botanical position is thus far unknown and indeterminable because its fruiting has never been observed. The fungus forms brown pustules of about the size and resembling in some degree the red scale, *Aspidiotus ficus*, differing from the scale, however, in always being on the under sides of the leaves.

The fungus attacks all stages of larvae and pupae, the vegetative threads penetrating all parts of the body cavity, bursting out as a fringe around the edges of the body, and then growing up over it, forming a compressed hemispherical brown wart or pimple (stroma), one over each larva destroyed. The size of the stroma depends upon the size attained by the larva when the fungus reaches it. From the base of the stroma growing filaments or mycelial threads reach out sometimes to the distance of half an inch in every direction. By such growth other larvae are reached and thus the disease spreads rapidly

over the surface of the infested leaf. Fragments of this mycelium are supposed to be transported by wind, birds or insects to other leaves, trees and groves where they start a new infection. The fungus does little or no damage to the leaf, never penetrating the tissues and only causing injury by smothering under many of the breathing pores. The appearance of a well matured case of brown fungus is well shown by the accompanying photograph (Plate III, fig. 3.) taken by Prof. Hume.

THE RED ASCHERSONIA (*Aschersonia aleyrodinis* Webber)
—This fungus is very conspicuous, forming more elevated pustules than the brown fungus, and which are of a ruby-red or pink color. The pustule, when matured, consists of a ruby-red center surrounded by a fringe of pinkish orange, sometimes approaching whitish. When immature the center consists of several to many ruby-red cups developing in craters of pinkish white. The red cups fill out, project slightly beyond their craters, and finally coalesce to form a ruby-red cone surrounded by a light pink base—the matured form. The deep red material consists of the sporules of the fungus and the lighter encircling ring is its mycelial woof. The mycelial threads do not reach out so far as those of the brown fungus and dissemination is probably accomplished altogether by spores. The sporules are gelatinous and adhere together so strongly in masses that the wind would seem unable to scatter them. The spores are loosened by the masses becoming wet, and heavy dews or light showers combined with a fluttering breeze so that drops of water are shaken from one leaf to another is probably one means of scattering them. If all the pustules were exposed to the full force of a heavy, driving rain, all the sporules would probably be dislodged and carried to the ground, but it is conjectured that their position on the under surfaces of the leaves protects them from too rapid dispersion under such circumstances, and at the same time gives possible opportunity for spreading them. The young larvae move about freely for several hours upon the leaves on which they have hatched and occasionally pass to other leaves, and while thus traveling can become infected with the disease before settling permanently;

however, it is safe to say that the insects that become infected in this manner are exceedingly few.

Ants are possibly important agents in distributing the spores. They visit the leaves for the purpose of feeding on the honey dew excreted by the white fly larvae and they could hardly pass over thoroughly infected leaves without entangling spores in their feet, especially if they were sticky with honey dew, and such spores would be readily transferred to the next larva visited. The first indication of larval infection is the appearance of translucent yellowish spots, usually near the edge of the larva, which becomes swollen and instead of throwing off its honey dew to the leaves beneath it, as is customary, allows it to accumulate over and around its body. The honey dew, being an excretory product, this early manifestation of the disease may be characterized as a violent diarrhoea. The hyphae or threads of the disease occupy a circle around the margin of the body, through which they eventually burst as a surrounding fringe. Death usually occurs before the hyphae appear through the ruptured margin. The threads, instead of reaching out over the leaf surface to any extent, grow into the larval body and over it, finally hiding it completely and forming the matured pustule as before described.

SPHAEROSTILBE COCCOPHILA Tul.—This fungus, well known as a parasite on scale insects, has been received from Orlando, growing upon *A. citri*. So far as can be judged at present its work upon white fly is comparatively insignificant, but under favorable conditions it might become a factor of considerable importance. The fungus appears, when matured, as stumpy, elongated, coral-reddish tufts around the body margin and on the dorsal surface, but rarely or never concealing the insect. The biology of this fungus is discussed by Prof. P. H. Rolfs in bulletin No. 41, of this Station.

BLACK FUNGUS OR SOOTY MOLD.—I have received the sooty mold covering the under surfaces of the leaves and smothering many of the larvae, with the report that it was "a fungus destroying the fly." In some instances I have seen 40 per cent. to 50 per cent. of the larvae smothered to death by it; it

has no effect in killing the insect until infestation is excessive, and ceases to operate as a destroying agent when the larvae are sufficiently reduced in number to stop the flow of honey dew over the lower surface of the leaf.

Methods of Introducing these Fungous Diseases into Infested Groves.

Until more is known of the developmental history of these diseases it will be wisest to approximate the conditions under which Nature spreads them as the surest way of getting them established where they do not at present exist. Introduction can, perhaps, be most satisfactorily accomplished by planting in the infested groves trees upon which the fungi are well established. The trees should be planted so that twigs of the infested ones interblend with those having upon them the diseased larvae in order that the leaves of the two may thus be brought into contact. If the transplanted tree is small it may be planted in a tub and elevated to the proper height on a box, or the tub may be fastened in the fork of the tree which it is desired to infect. Even this method sometimes fails but it commonly succeeds. The time of transplanting is not important, the essential point being to get the tree to growing without dropping its leaves.

Pinning of fungous infested leaves with the fungous pustules in contact with the healthy larvae of uninfected leaves and thus leaving them; spraying with spores of the fungus and fragments of its mycelium suspended in water; hanging of cut infected branches among uninfected ones; inoculation by means of lightly pricking the larvae with a needle which has just been immersed in water containing an abundance of spores and fragments of mycelium; and placing the infected face of a leaf in contact with the larvae on an uninfected one and securing them in this position by means of a cheese-cloth band which binds in a moistened plaster of cotton or moss on each side of the leaf, have been tried by various experimenters, myself included, without marked success. However, an infection



Fig. 1.

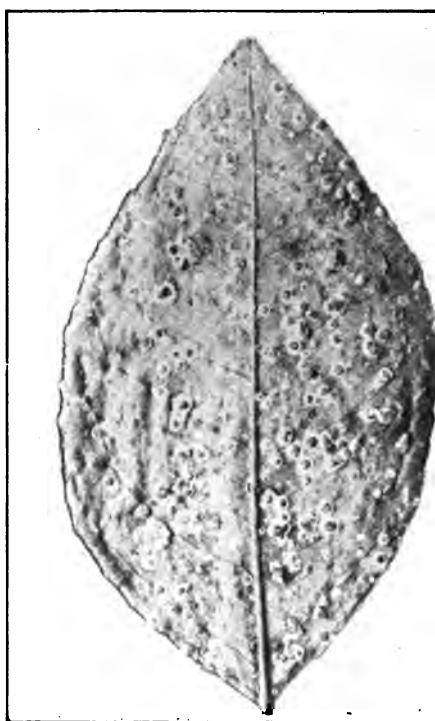


Fig. 2.



Fig. 3.



Fig. 4.

PLATE 3. (PHOTOGRAPHS.)

Fig. 1.—Larvae and pupae of White Fly on Orange.

Fig. 2.—Red Fungus, *Aschersonia alcyonidis* Webber.

Fig. 3.—Brown Fungus on Orange.

is sometimes started by these methods. When the last is used the cotton or moss is moistened by pouring water upon it every two or three days and the bandages are removed in a week or ten days; care must be taken not to make the bandage so heavy that it will break off the leaf when the cotton is saturated with moisture.

How Far May the Fungus be Trusted to Destroy the Fly?

Different observers will give different answers to this question. Some intelligent growers, located near the coast in South Florida where conditions of heat and moisture are as favorable as they possibly can be for fungus growth and development, are sanguine in the belief that no spraying is necessary, while some of their neighbors are equally confident that the highest degree of profitable production can only be reached by diligent spraying or fumigation. Classed with neither the sprayers nor the non-sprayers is a numerous contingent that is confused between the claims and practices of the two schools, and therefore its representatives spray a little, then wait a year or two for the fungus to develop, then spray a little more, then wait again for the fungus to appear. This mixing of the practices of the two schools fails to secure the benefits of either and groves that are improperly, intermittently or rarely sprayed would best be left wholly untouched if any fungus is present in them. I once thought there might be a middle road of practice between the two schools and that by observation of the natural agencies at work to destroy the insects it could be decided whether spraying was or was not necessary. While this may be true under some circumstances, careful observation for four years has convinced me that for the orange grower in Florida the truth lies at the two extremes of practice and not at all between them. I cannot too emphatically state my conviction that if one in this State is to trust his natural friends to destroy his insect enemies, he must carefully study the habits of these friends, introduce them, propagate them, disseminate them, and allow them to spread and multiply without hindrance by the application of caustic sprays which destroy friend and

foe alike. Fungi are easily destroyed by alkaline washes and soaps, whether the alkaline base is caustic potash, caustic soda, or lime; and in Florida with its long, hot, humid summers fungous diseases are commonly many times more effective than predaceous or parasitic insects. Where fumigation is practicable it has one distinct advantage over spraying in that it does not destroy fungous growths. The man who is not willing to leave the safe-keeping of his grove in Nature's hands should plan to spray regularly several times each year and the expenditure should be counted upon as an outlay just as necessary as is his fertilizer bill. I believe that seventy-five per cent. of the groves in this State, whether infested with white fly or not, if handled in this way, would show an improvement as marked as a properly fertilized grove shows over an unfertilized or an improperly fertilized one. I repeat emphatically that while I have no word of condemnation for the man who with intelligence and skill directs Nature's agencies so that he secures results with most insects equal to the best (and we have some such in Florida), I believe that white fly is an insect that should be fought by everybody with insecticides from the day it is discovered in a grove. I admit that there is no spray that will kill white fly and not at the same time inflict injury to the trees upon which it is so often applied, but I am satisfied that the injury is far less than white fly causes, except during exceptional periods when fungous diseases are unusually active. Infested trees that are properly sprayed through many years and are correctly treated in other respects, I believe will live longer, yield better, and give much larger net profits than they will do if fungi alone are relied upon for protection.

The views of Mr. A. J. Pettigrew, being based upon many years of observation and the trial both of spraying and depending upon fungi, I think too valuable to omit. Mr. Pettigrew regularly sprays such of his groves as are planted on pine land in open fashion, that is where the distances between the trees are great enough to admit of the free circulation of air among them; but in case of close-planted trees on hammock soil and

especially when still closely surrounded by hammock woods, he depends wholly upon fungi.

Many of the attempts to introduce the fungi into the upper parts of the State have failed, and I have never seen the diseases doing effective work very far from the coast. In old orange days Prof. Webber records having seen the red *Aschersonia* in abundance at Gainesville and Panasoffkee. At present the districts in which the two important diseases are really successful are along the Manatee river and about Fort Myers. It is impossible to accurately judge at present what these fungi will do in the upper and interior parts of the State.

For practice, I recommend that one having an infested grove either spray it or fumigate it according to circumstances; that he persuade his neighbors to do likewise if possible; if the neighbors are obdurate and will not treat their trees, persuade them to introduce the fungi as the next best thing; if they will not do this it may be worth while to introduce the diseases for them and then work to create a State Entomological Department with sufficient resources at its command to enable it to supervise the introduction of such valuable fungi into every neglected and infested grove in the State.

Mr. A. J. Pettigrew, Manatee, Fla., has kindly given permission to refer to him as being prepared to supply for the trade, trees having upon the leaves both the red and the brown fungus in suitable condition for introduction into new localities. The frank honesty, which through many years has characterized Mr. Pettigrew's dealings with the public and which now, in the interest of the public welfare, induces him to allow the use of his name in a way that most nurserymen would shun, deserves the appreciative consideration of our people. If some citizen had not consented to do what Mr. Pettigrew has done I know of no regular source of supply of these diseases that could have been named, and I am not provided with the resources by which the work could be undertaken by my department. I feel sure that no one need fear to order defoliated, clean stock of Mr. Pettigrew, for his past record and present attitude is a certain guaranty that it will be furnished.

Sprays.

As before noted three of the four pairs of spiracles or breathing pores of the larva are on the under surface of a V-shaped fold or groove, with the apex directed backward, which is readily observed at the anterior end of the body, approximating the separating line between the head and thorax; and indeed this fold was once supposed by entomologists to be the dividing line between head and thorax; but as observed by Prof. Woodworth, it is wholly thoracic in position and is a specialized apparatus for respiration.* Another or fourth pair of spiracles is on the under surface of an anal groove or fold. Since the larva is very closely pressed against the leaf and the only ingress of air to the spiracles is through the grooves or breathing folds mentioned, the efficacy of the resin sprays which close up the outside apertures of the breathing folds is readily understood. It is only necessary to obtain a ring of resinous wax around the body-ring of the larva, thus forming an hermetical seal, to suffocate it. If one or more of the four tube openings are left unstopped while the others are closed the insect will probably survive just as a man with one lung will survive for a time; and if a rain comes to uncover the stopped tubes within ten or fifteen days, it will probably recover altogether, whereas, if all the tubes are closed it will die in a few hours. The structure of the insect would seem to indicate that a fine and evenly distributed spray would be most effective; but resin wash, going through a fine nozzle, froths a good deal, including so many air bubbles that a certain degree of coarseness of spray gives best satisfaction. A caustic property in the spray is also important in order that death may result before rains dissolve off the wash.

The formula in general use and which is most satisfactory, for regular work, cost and efficiency considered, is the one originally recommended by Prof. Webber, and is as follows:

*Canadian Entomologist, Vol. 23, June 1901, p. 173.

- 1 Resin, pulverized 20 lbs.
 Caustic Soda, granulated, 98 per cent . . . 4 1-4 lbs.
 Fish Oil 3 pts.
 Water for final bulk 150 gals.

A somewhat cheaper formula is the following:

- 2 Resin, pulverized 20 lbs.
 Crude Caustic Soda, 78 per cent 4 lbs.
 Fish Oil 2 1-2 pts.
 Water for final bulk 100 gals. to 150 gals.

Ordinary commercial resin, such as is bought by the barrel in Florida, is satisfactory, and the caustic soda is of the quality used in soap factories. The crude soda comes in drums of from 112 to 200 pounds each.

Another formula which has given good satisfaction to some growers because of the convenience of quickly obtaining the materials without ordering them from a distance and of keeping the soda indefinitely without special precautions is as follows:

- 3 Resin, pulverized 20 lbs.
 Caustic Soda (Star Ball Potash, pulverized) 7 lbs.
 Fish Oil 3 1-2 pts.
 Water for final bulk 100 gals.

Resin costs 1 1-4 cents per pound, or if obtained direct from the naval stores farms 1 cent per pound or less. Caustic soda is quoted in Jacksonville at 8 cents per pound in ten-pound cans, 7 1-2 cents per pound in 25-pound cans, 7 cents per pound in 50-pound cans. This substance rapidly absorbs water from the air, becoming a very caustic liquid and is therefore best purchased in packages, the entire contents of which can be used at once after opening. If small quantities of spray are needed the smaller packages should be purchased. The crude caustic soda costs from 3 1-2 to 4 cents per pound in New York, f. o. b., and cannot be obtained in small packages. It becomes of an adamant hardness after being exposed to the air for a few days and should be worked up at once after opening the drum. It is suitable for use where the grove is large and the

spraying outfit, from preparing plant to number of nozzles at work, is of considerable magnitude. Star Ball Potash comes in cases of 48 pounds each, one-pound balls, at \$3 per case or 6 1-4 cents per pound. It may be exposed to the air for any length of time without being injured as each ball is covered with a resinous jacket. It can be obtained from almost any large grocery. Fish oil costs about 50 cents per gallon. The materials for 100 gallons of spray made by formula 1 will cost about 51 cents, by formula 2 about 60 cents, and by formula 3 about 90 cents. Formula 1 diluted to the same degree as the other two will cost about 76 cents per one hundred gallons.

As a smothering wash formula 1 is probably equal to 2 and 3, but its contact effects are less satisfactory. If the wash is to be used in summer the dilution is about right, but for winter use better results are secured by diluting to 100 gallons instead of 150. The materials for resin wash can be had from almost any wholesale dealer. Among the best known firms in Florida may be named E. O. Painter & Co., Wilson & Toomer, and C. R. Tysen, all located at Jacksonville.

The details of preparation are the same no matter which formula is used. Procure a large iron kettle, a hog scalding vat is excellent, and another smaller kettle for hot water. If a large kettle of from twenty-five to forty gallons capacity is unavailable, a number of smaller ones can be used, the materials being divided between them as they are weighed out and measured. Heat in the large kettle thirteen or fourteen gallons of water, having previously placed the materials given in one of the formulae in the bottom. If the water is hot before the materials are put in, add the resin and fish oil first and then the soda in small lots to prevent a sudden boiling over. Boiling is best continued for two or three hours over a hot but not too brisk fire. One hour's boiling or less will give a mixture which can be used but results will not be as satisfactory as when the wash is more thoroughly cooked. Whenever there is a tendency for the liquid to boil over, subsidence will quickly occur if a pint or more of water from the water kettle, which is kept warm but not boiling, is added. Never add cold water while

the wash is cooking if you desire results that are certain. Increase the quantity of solution by gradual additions of warm water until a stock solution of thirty gallons is obtained. For use, this is to be diluted to one hundred-fifty gallons in case of formula 1, to one hundred gallons with formula 2, and one hundred gallons with formula 3. The stock solution may be kept for a time and used as desired, but the wash is best used as fast as made. Any sediment or settling in the stock solution indicates that cooking was incomplete and must be repeated. Where a steam pump is possessed or a head of steam is available a set of barrels may be arranged with steam pipes leading through them and resin wash can be prepared rapidly and in quantity by boiling with steam. The stock solution should be strained before diluting it to remove any particles or trash that would clog the pump nozzle.

Other Sprays and Remedies than Resin Wash.

KEROSENE EMULSION.—Kerosene used as an emulsion or in a ten per cent mechanical mixture with a kerowater pump is an efficient destroyer of the larvae and eggs of the fly, but is somewhat uncertain in its effects upon the tree. The emulsion, properly made, is much more reliable than the mechanical application, made with a kerowater pump. Bright, sunny days with a dry atmosphere should be chosen for making kerosene applications. If applied upon a cloudy, humid day that is followed by several days of cloudy weather, thus interfering with rapid evaporation of the oil, very serious injury to the trees is apt to follow. From ninety to ninety-five per cent of the larvae are killed by one thorough application. An occasional spraying with the emulsion may not be objectionable, but I do not recommend it for continuous use. Crude petroleum should never be used upon citrus trees.

WHALE OIL SOAP.—Any good whale oil soap will be found useful in fighting white fly. Of the hard, or soda soaps, Leggett's Anchor Soap is probably not surpassed. The true potash soaps seem to give better results with the insects and trees, con-

sidered together, than any of the insecticidal washes, when used continually for several seasons, as must be done in case of white fly. Good's Potash Whale Oil Soap No. 3 is well suited for such use and is safe as a summer application. Used at the rate of one pound to four gallons of water it will kill about sixty per cent of the grown larvae in March, and, when used at the rate of one pound to three gallons of water on half grown larvae in May or early June, from eighty-five to ninety-five per cent of them are killed. Though a very heavy rain fell within two hours after making an application at the latter strength in early June, not less than ninety per cent of the insects were dead two or three days afterwards. Leaves, having upon them pupae from which the adults were emerging and larvae in less advanced stages, when immersed for ten minutes in a solution of the soap, one pound to four gallons of water, have invariably had all the insects upon them killed unless they were peculiarly sheltered.

In laboratory experiments, Good's Tobacco Whale Oil Soap No. 6 did not seem more effective than did the No. 3 soap, but in the field one pound of it in five gallons of water seemed to give somewhat better results than one pound of the No. 3 soap in three gallons of water. Leggett's Whale Oil Soap Compound a true potash soap, used at the rate of one pound in three gallons of water, gave, in the field, about the same results as Good's No. 3, but in laboratory tests it seemed to be not so effective.

For summer use and for trees that have been weakened by the use of more severe sprays, the potash soaps are especially recommended.

Purchased by the half-barrel, Good's Potash Soap No. 3 costs 3 1-2 cents per pound; or, if used at the rate of one pound in three gallons of water, one hundred gallons of spray will cost \$1.17; if the dilution be one pound to four gallons of water, one hundred gallons of spray will cost .87 1-2 cents.

HAMMOND'S THRIP JUICE.—This preparation made by Benj. Hammond, Fish-kill-on-the-Hudson, N. Y., is apparently a very concentrated potash-tar soap which readily dissolves

in warm water. In twenty gallon kegs, it costs \$1.60 per gallon, and as the dilution recommended is one part of Thrip Juice to one thousand parts of water, one hundred gallons of spray will cost sixteen cents. Used at the dilution given results have not been satisfactory at all as compared with those gotten with the use of potash whale oil soaps applied at the same time and under the same conditions. A few of the younger larvae were killed, but nearly all of the well-grown ones survived. It is possible that this insecticide, diluted about one part of Thrip Juice to eight hundred parts of water, will prove a valuable application to use about the middle of May or a little earlier when the larvae are all quite young.

MONTGOMERY'S INSECTICIDE—Apparently a potash-soda-tar-resin preparation, with possibly other unknown ingredients, the whole quite resembling the ordinary resin wash. Since part, and possibly the largest part, of its base is true potash, the wash is apt to be more stable than the ordinary soda wash and is therefore probably better suited for summer use than many preparations. The full effect of the wash is not apparent until several days have passed after spraying, but so far as tested, results have been quite as satisfactory as with any preparation used. The stock preparation is sold by Dr. L. Montgomery and Son, Micanopy, Fla., at \$8.75 per barrel of 50 gallons. For use, the stock preparation is diluted one part to seven or ten parts of water; one hundred gallons of spray, therefore, cost \$2.50 at the former dilution and \$1.75 at the latter.

TOBACCO DECOCTION.—Tobacco infusions at all strengths are practically worthless, the effect on white fly larvae being little more marked than if rain water were used. The larvae may be immersed in such decoctions for several hours without being killed. Roseleaf Insecticide, a patented preparation of tobacco extract, gives results but little better than the ordinary decoction.

SULPHUR DUST.—Dusting the trees liberally with flowers of sulphur when the young are hatching has been found to be of no value at all.

CAMPBOR BALLS.—Camphor balls enclosed in cheese cloth sacks and tied in the trees as repellants are worthless.

LIGHT TRAPS.—Trapping the adults with lights gives no results worth mentioning.

FIGHTING THE ADULTS.—Warfare of any sort directed against the adults is doomed to failure, since the females generally lay their eggs within twenty to forty-eight hours after hatching.

When to Spray and What to Use.

Spraying must be so timed that the greatest number of insects are destroyed, and another and even more important consideration is to avoid injury to the tree, bloom and fruit. Spraying cannot be done effectively while the insect is on the wing. There are three larval periods, the longest of which extends from late November until the first of March; another extends through May and June; another without well defined limits through late July, August, September and October. The winter larval period offers the best opportunity for satisfactory spraying. Two thorough applications of resin wash should be made during this period as a regular practice and, if a grove is badly infested, the first year that spraying is adopted three may be made with profit. The earlier the spraying is done the less will be the sapping of the trees by the larvae during the winter. The first spraying should be done in December, if possible, and the second in January. A third may be made in February.

Spraying should cease when the blossoms commence opening, but may be continued until the buds are swollen and ready to burst. A swollen bud in spring is not more liable to damage from a resin spray than it is during the winter. No spraying with resin wash should be done during April, May or early June. Some growers have dropped many thousands of dollars worth of fruit by spraying in late May in South Florida, and as it has been the experience of not a single grower but of a number and of not a single season but of several, the conclusion must

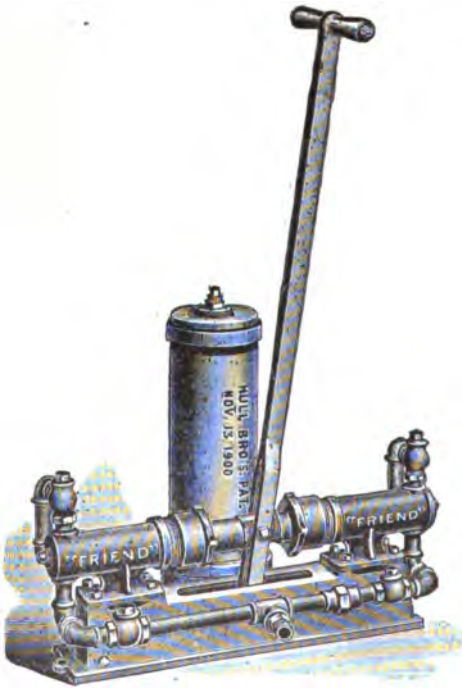
be stated with emphasis that spraying bearing trees with resin wash during the spring larval period is hazardous. Late May in South Florida corresponds to early June in the northern orange section. Spraying with resin wash at any time during June is questionable.

So far as present experience and reports indicate a potash whale oil soap may be used with safety after the fruit has been set for two or three weeks. Where the flies are bad a soap spray may be used in late May or early June. This will diminish the June and July hatching of adults and therefore tend to hold down the numbers of the second brood of larvae which cause the smutting of the fruit. Either the resin wash or soap can be used in July, August and September without danger of dropping fruit, but some scarring and burning will be caused by the former. For summer use I am inclined to believe that a potash soap, used exclusively, will give best results. If a quart by measure of flowers of sulphur is dissolved by boiling with ten pounds of soap in twelve or fifteen gallons of water, the solution being diluted to thirty or forty gallons of liquid for use, a spray is obtained that is effective against the purple and six-spotted mites, the rust mite, scale insects and white fly. Three or four well made applications during the summer, about a month apart and timed to catch the white fly larvae, will keep the fruit free from rust, scale and sooty mold if winter treatment was properly made.

How to Spray.

A good force pump, capable of supplying two to four nozzles and of elevating the spray when required to a height of thirty-five or forty feet is a necessity. Among the hand pumps that can be recommended as filling such requirements may be named the "Friend" pump made by the "Friend" Manufacturing Co., Gasport, N. Y., and the Gould Sentinel Junior pump made by the Gould Manufacturing Co., Seneca Falls, N. Y. There are other good pumps than these, but as I have had practical experience with both of these machines as well as

others I can pronounce them among the best. The latter is well known to our growers. The former is yet a stranger to them, but is something unusually good and deserves an introduction for high power work. If steam, gasoline engines or compressed air pumps—capable of supplying from six to twelve nozzles—are wanted, correspond with such firms as these: Gould Manufacturing Co., Seneca Falls, N. Y.; Friend Manu-



The "Friend" Pump.



Gould's Sentinel Jr. Pump.

facturing Co., Gasport, N. Y.; Wm. Stahl, Quincy, Ill.; Deming Co., Salem, O.; The Pierce-Loop Sprayer Co., Northeast, Pa., or Field Force Pump Co., Lockport, N. Y.

The leads of hose should be long enough to carry the extension rods, well towards the tops of the trees. Ladders are sometimes used in reaching the tops of very tall trees. A high

platform is sometimes erected on the spray wagon above the tank on which the operators stand to reach high tops, but as spraying for white fly must be from the inside of the tree outward instead of from the outside inward, such a platform is of little use unless the wagon is driven very close to the tree. Brass extension rods encased in bamboo are less unwieldy than the ordinary gas pipe extension rods and should be eight or ten feet long.

Nozzles that can be adjusted to throw either coarse or fine spray are to be preferred for applying resin wash or whale oil soap, and the spray should be put on as fine as it can be and at the same time carry well to the foliage. Resin wash when too fine behaves like fine soap bubbles, drifting in the air instead of going to the point at which the nozzle is directed. Nozzles of such types as the Nixon, Bordeaux, McGowen, Seneca, Masson, etc., are suited to this work. For applying any of the preparations of kerosene a fine Vermorel nozzle should be used.

A nozzle than can be adjusted to any angle so as to reach the under side of the leaves from any position, such as the Gould's Carnation or Erin, is at times a convenience but is not so necessary as it may appear to be to one who has not learned that the underside of nearly every leaf upon a tree, as ordinarily grown, can be covered by using a straight rod nozzle. The underside of every leaf must be hit and well covered with spray to kill the white fly larvae. The operator must not be afraid of the drip and should stand well under the tree and thrust his rod through the forks so the spray will be thrown with good force against the lower leaf surfaces. For high trees having thick foliage a powerful pump is necessary to drive the spray through to the top.

Some growers prune out all the interior growth from their trees so as to leave them hollow cones. Such trees are easily sprayed, but other growers believe the resulting gain is more than offset by losses in other directions. An excessive growth of water sprouts is often stimulated by too severe pruning, and these are specially attractive to the flies. A growth of water sprouts is the normal outcome of an effort by the tree to remedy

an abnormal condition—that is, to balance a sufficient top growth against a root system that is overdeveloped. Insufficient drainage is a cause sometimes inducing excessive root growth, and hence indirectly influencing the development of water sprouts. Cutting all of them out, along with the interior fruit twigs, encourages a new and more numerous growth of them. Where it is possible to do it train them to grow outward in the foliage zone and allow them to harden and become ordinary normal wood as soon as they will. When they are in the heart of the tree and numerous it is necessary to cut them out as well as dead twigs before spraying is commenced.

Trees upon tall trunks are readily developed into the hollow cone. I believe the foliage zone of such trees should be deep, and if spraying seems difficult effort should be directed toward obtaining a pump of higher power rather than to diminish the depth of the foliage by pruning. If low branched, squatty trees are more difficult to spray, they are much easier to fumigate than high-topped ones, but can also be sprayed successfully.

With low trees an adjustable or elbowed nozzle for throwing the spray upward is almost a necessity. The operator will often find it best to thrust his rod through to the side of the tree opposite from where he is standing, thus hitting the under surfaces of the leaves on that side. With low-topped trees having dense foliage most of the work must be done by this method. Some of the leaves, especially at the top, are best reached from a position outside and away from the tree. A clever operator will quickly learn by experience how most conveniently to send the spray where it is needed. The quantity of spray used should be liberal. One thorough spraying is cheaper than two that are half done. Trees from 12 to 20 feet high will require from 8 to 15 gallons of spray; from 20 to 30 feet high from 15 to 25 or 30 gallons of spray. Use more than these quantities rather than less.

The following extracts are taken from letters bearing various dates, written by well known orange growers whose large

experience with resin and soap washes gives deserved weight to their opinions:

"I have used resin wash against white fly for eleven years with perfect success. My long experience with its use has made me very familiar with its effects on trees and fruit at whatever season of the year applied. Several years ago I lost many hundreds of boxes of fruit by using it in May. I used it again last May, the weather conditions being identical with what they were when I previously lost fruit, namely, very hot and dry. I think the resin draws the heat and scalds the oranges. An experiment in which I diluted Professor Webber's stock solution of wash to 180 gallons instead of 150 gave the same results. We lost last May 1,000 boxes of oranges worth from \$2,500 to \$3,000 had they matured. William Palmer, Sam Harris and L. C. Randall all used the wash at the same time with the same results. I am positive that the wash will take the fruit off every time in the May period.

"I have kept the white fly under control ever since I commenced spraying. The only trees that ever became black with smut were near neighboring groves that were never sprayed at all, or else not thoroughly. The fly has not yet reached some parts of my grove. (Mr. Kirkhuff's grove contains about 2,300 trees.) I have sometimes thought the resin spray has some effect in hardening the bark. I thoroughly soak the entire tree. I find, when so applied twice, it takes off about one-third of the foliage and causes ripe fruit to drop badly. I have sprayed in August and September when the weather was dry and had good results in keeping down the sooty mold on tree and fruit. Nearly all the larvae were killed.

"I commenced by spraying once in January, once in May and once in August. After discovering the danger of spraying in May I gave one application in winter, one in August and another in September. I now spray in winter making two very thorough applications. I believe that I do not have fifty trees out of 2,300 that have any smut on them. I may be obliged to wash a few boxes of oranges."—W. I. Kirkhuff, Braidentown, Fla.

"I was well pleased with the results of spraying for white fly last season. My tangierine grove was comparatively free from fly, so much so that I shipped all the fruit without washing any of it and it was 90 per cent. 'fancy bright.' Only about 200 boxes out of 3,500 from the Bank of Kingwood Grove were touched by the fly and these not badly. By being careful to keep all the water sprouts from the trees and spraying well (with resin, fish oil and Star Ball Potash) once or twice in January or February we have kept the fly out of our groves for the past two years. Mr. Nichols was well enough pleased with his last year's spraying to spray again this year.

"I have never sprayed with resin wash in the spring, June being the earliest date I have tried. I have never had any fruit to fall from the use of the wash, but have had a small percentage of the fruit to burn where it was most exposed to the sun—perhaps from 2 to 5 per cent. of it; from the entire grove, 2 per cent. would probably cover the amount of burnt fruit."—C. P. Fuller, Ellenton, Fla.

"I beg to say that after making experiments with varying strengths of the Good soap, I have found 18 pounds to 50 gallons of water just right. I would not hesitate to spray at any time with this soap, and have actually sprayed the bloom to kill thrips, apparently without injuring the crop of fruit. It is a safe preparation to use, and I have found it will rid the trees of scale, and I feel sure it will be effective against the white fly.

"I have long contended against the use of resin wash and have had, in the past, bad results on young fruit from its use."—E. P. Porcher, Cocoa, Fla.

"I have no very definite idea as to the effect of spraying very young fruit with Good's whale oil soap, as I have always avoided spraying trees when fruit was passing through the dropping stage. By the time that the fruit is the size of marbles most of the weak ones have dropped off, and from this time on I have used Good's potash soap without seeing any bad results from it, but I have burned spots on oranges two-thirds grown with soap of my own make when used at a strength

of one pound to four gallons of water; but this soap was much stronger than Good's, having less than one-half of the water in it that Good's has.

"I have never noticed any direct injury to trees from one application of resin wash, but when applied as often as three times inside of three or four months it certainly does injure a tree to such an extent that it will take an entire season for it to recover."—C. W. Butler, St. Petersburg, Fla.

Mr. Porcher and Mr. Butler have not had experience in spraying for white fly, but their knowledge of the comparative effects of the resin washes and potash soaps upon trees and fruit can be depended upon as valuable.

Scalding Action of Resin Wash Explained.

Sodium resinate, formed by boiling together sodium hydroxide and resin, is a salt composed of a strong base and a weak acid; in the presence of moisture it easily separates again into sodium hydroxide and the original acid. Chemical separation is especially apt to occur if cooking the wash was incomplete or hurried. The following, therefore, is the probable explanation for the scalding and falling of the fruit:

The hermetical seal or covering of resin on the young fruit prevents evaporation, thus confining, within, the moisture necessary to cause the dissociation of the chemical elements constituting the inside of the resin jacket; and these being held by the outside layer of resin in contact with the young and tender fruit pulp for an indefinite time cause scalding and burning, culminating in the dropping of the oranges. It is also possible that there is some accumulation of heat inside the resin shell. Anyone who has worn a pair of rubber boots for a short time in the sunshine on a hot summer day knows that his feet scald. The explanation is found in the fact that evaporation is prevented, and rubber also possessing a great capacity for absorbing heat, an accumulation of it occurs inside the boot. By a somewhat different principle glass enclosures accumulate

heat within, the phenomenon of plants burning in a closed greenhouse in hot sunshine being a familiar one. According to the results obtained by Mr. W. W. Coblentz of Cornell University, resin is not highly diathermous like glass, but possesses a moderate transmitting power for heat. I think it not improbable that the accumulation of heat inside the resin shell is sufficient to stimulate the chemical activities which, but for its presence, would inflict less injurious effects. As the fruit increases in size it becomes of tougher character and, relatively, so small a portion of the pulp is burned that scalding occurs only in spots, not involving enough of the flesh to cause falling. It is also conceivable that, to a smaller extent, drops of the wash accumulating on the undersides of the fruit, harden into more or less persistent concavo-convex lenses with sufficient curvature to focus such of the sun's rays as strike them to centers inside the shell, thus furnishing an excess of heat in a local spot, possibly not enough in itself to cause burning but sufficient to encourage unusual chemical activity in any free sodium hydroxide near such a point. No matter which is the primary agent in causing the falling, whether chemical or physical, it is associated with hot, dry weather and direct sunshine, heat being an important factor in causing it. Besides the original accumulation of wash in drops on the lower part of the fruit, the dews and light rains will regularly carry more of it to the same spot and at the same time stimulate chemical disintegration, thus subjecting such spots to the action of sodium hydroxide for a continuous and indefinite period. In like manner some of the fruit may be so located that the drip from dew or light rain from above falls constantly on the same spot, causing a scalded place on the upper surface or side.

The relatively large calyx cup receives and holds considerable quantities of the spray and this in breaking up into sodium hydroxide and resinous acid would scald the tender stem of the fruit, inducing shriveling and falling. It is probable that most of the dropping is caused by injury to the stem.

Fumigation.

Fumigation with hydrocyanic acid gas is recognized in nearly every progressive citrus producing country in the world as one of the most effective methods for destroying orange pests. A process that has been found so valuable in every other part of the world is certain to eventually come into favor in Florida. The conditions that exist in our State set some limitations upon its range of usefulness and I think it should not be "boomed" into disfavor, but a gradually increasing number of growers can adopt it each year with profit. The Florida growers have had little experience in fumigating trees and think the method intricate and mysterious. Familiarity with such work removes such misconceptions and it is discovered that a fumigation outfit is not more mysterious or difficult of mastery to an orange grower than is a spray pump with its accompaniments to a grocer. It is well-nigh necessary, however, to secure the help of an experienced fumigator when beginning such work.

Since it will be necessary, at a later time, to publish directions for fumigating in the field I will burden as little as possible the already full pages of this bulletin with the details of such work, giving only a resume of the results reached two years ago while working in conjunction with Prof. C. W. Woodworth of the California Experiment Station. Upon Prof. Woodworth's arrival in Florida, our first work was to visit the McFarland Tent Factory, then located at Titusville, and look to the selection and treatment of cloth, patterns of tents, etc. Six ounce drilling, treated with paraffine, a sort of cloth used by the company in the manufacture of tents for protection against cold, was tested, but seemed to allow too much escape of gas. Several patterns of tent, sheet, hoop and bell were made ready, using either eight ounce duck or six ounce drilling, some of our largest bell tents for trees thirty feet in height and twenty-five feet in diameter being made from the latter material. In practice, the drilling proved quite satisfactory for the smaller tents, but was too easily torn for heavy work. Subsequently,

the people of Candler, Florida, have used a light, six-cent muslin quite satisfactorily, but I am inclined to recommend heavier cloth. The cloth for the Station tents was mildew-proofed at the factory, and when on the ground where it was to be used, was painted with linseed oil, into which enough lamp-black was stirred to give body and color to the preparation. We experienced some trouble with burning of cloth; in fact, found it impossible to paint a large bell tent without serious damage, necessitating extensive patching, unless the derrick upon which it was swung was in perfect working order and repair, so as to avoid the risk of leaving a fold in the canvas for even a short time while drying out. The weight of oiled tents is also a great objection to them. Cactus juice, which is sometimes used in California, is not available in Florida in sufficient quantities for tent treatment and some new application must be found. Fortunately a preparation, known to sailors in tropical waters has come to my attention and, except that it renders cloth somewhat objectionable for handling, has thus far given good satisfaction. Mr. Arthur Weaver, who superintended the fumigating of Mr. A. G. Liles' grove, used the preparation and reported it lighter, cheaper, and in all respects superior to oil with which he had had equal experience. It seems not to burn cloth and to be mildew-proof. Cloth so treated and in use upon boats in tropical waters is reported to last for five or six years. The following is the formula as developed and employed by Mr. Weaver: Five pounds white lead, fifteen pounds of laundry soap, chipped, ten pounds of lamp-black, two gallons of boiled linseed oil, six gallons of water. Heat to boiling two vessels of water, having three gallons in each. In one dissolve the soap and keep the other hot. Thoroughly pulverize the lamp-black by stirring and mixing well with one-half gallon of vinegar. Now add the lamp-black to the linseed oil, stir, and pour into the soap solution. Add the white lead, mix the whole thoroughly, using all the water, and apply to cloth with brush, keeping the paint hot enough to just show steaming while being used. If the first coating is not sufficient, reverse the tent and give an application to the opposite side.

For trees not over twelve feet high I found hoop tents most satisfactory; above that to twenty feet in height I think sheet tents will prove best; above twenty feet the bell or sheet will be most satisfactory. As one result of the work a new pattern of derrick was devised for swinging large bell tents, which seems more flexible to varying requirements than the California patterns; or perhaps I should designate tents handled after this plan as box tents, for they are swung in pairs with the derricks upon the same general principle as the box tent; i. e., the type of box tent described in Bulletin 122 of the California Station, the derrick taking the place of a lifter. The idea that a bell tent might be swung like a box tent was due to Prof. Woodworth, who mentioned it upon the day of his departure, and the practical working out of the idea was achieved by the writer's combination of ideas derived from various sources; Mr. Arthur Weaver's suggestions were especially helpful.

Our derrick consists of a main mast of spruce pine about thirty-five feet high for trees thirty feet in height, and stands between the rows to be treated. To each side of it is attached a gaft twenty-two feet long, also of spruce pine. The foot of the gaft clasps the mast with arms of oak, being raised and lowered with double blocks and pulleys exactly after the manner of a ship gaft. The top of the gaft is double blocked and pulleyed to the top of the mast, so by means of its top and bottom attachments the gaft can be raised to any height, its top many feet above the top of the mast if necessary, or it can be lowered to reach the ground. Since it can take any angle of direction also, it may be quickly adjusted to trees of any height and of variable distances apart. The top of the bell is attached by pulley near the end of the gaft. Three trail poles of hickory, each about ten feet in length, are fastened to one side of the lower border of the tent, their ends being securely lashed to each other with rope, so when they pull against each other the rope and not the cloth will catch the strain. The cloth is caught up and bagged slightly at these points of union of the trail poles as additional protection against

tearing. The center of each of these trail poles is connected with the top of the gaff by pulley, and thus the border of the tent to which they are attached may be elevated to any height, the opposite border swinging free, within reach, near the ground. A trail rope is attached to each of the trail poles. All pulley ropes belonging to the apparatus are secured to cleats on the mast.

In operation, when the main mast, on rollers or wheels, has been placed in position, the height of the tree to be fumigated and its distance from the mast are noted, and the foot of the gaff is raised or lowered to the point of greatest advantage as learned from experience. A similar adjustment is made of the top of the gaff. The top of the tent is next drawn fully up and then the three trail poles; the hanging free edge near the ground and as much of the border as possible is now brought into position, and the top of the gaff lowered some if necessary. Slack is now given to the trail poles and a man at each trail rope so pulls the pole to which his line is attached that the whole tent drops into position over the tree. The lower border of the tent must be extra strong to avoid tearing; it is best bound with rope. To remove the tent from the tree the procedure is almost exactly reversed. With men trained to work together, the tent may be lowered over a tree in seven or eight minutes and removed in about five. Since the operation of removing the tent from one tree raises it almost in position to drop it upon the next, the time required for changing will not be the sum of eight and five minutes, but the last five minutes is divided between the two trees, removing from the one and at the same time getting almost in position to lower upon another by a quick adjustment of the angle of the gaff, it requiring less than eight minutes to cover a tree from this position. The apparatus requires four men, one of whom may be the fumigator if he has his materials weighed out beforehand. A gang of four can operate about four tents or two derricks, if the rows are not more than twenty-five or thirty feet apart. This gives forty minutes time to the tree and allows ten minutes for shifting of the tent. In order

to realize this expeditiousness in practice all apparatus must be in perfect working order and repair and the men trained to handling it. The results secured in my practice satisfied me that this would be a reasonable estimate, for it was done often enough in this time with our then imperfect apparatus to justify such a conclusion. Full specifications and illustrations of the derrick at work will be published later on in bulletin form.

Some determinations suggested by Prof. Woodworth and made by Prof. Miller, of the Chemical Department, are of interest and importance. He found that one ounce of sulphuric acid and one ounce of water, mixed and cold, when added to one ounce of potassium cyanide, yielded 428.4 cubic inches of gas; that one ounce of sulphuric acid and one ounce of water, mixed and added immediately, while warm, to one ounce of potassium cyanide, yielded 467.9 cubic inches of gas, greater by a little more than nine per cent. than with a cold mixture of water and acid. Mixing the acid and water, therefore, only as used, means a saving of six or seven cents per tree on large trees requiring two pounds of cyanide. He further determined that a greater proportion of acid did not materially alter the results, and that ammonia seems not to be formed immediately after the reaction, under laboratory conditions.

A number of experiments were made with citrus twigs, orange, lemon, pomelo, etc., infested with white fly, to determine the susceptibility of the insect to the gas, dose of chemicals to use, length of time necessary and most favorable temperature for treatment, influence of moisture being present upon the leaves when fumigated, etc.

It was found that the insect in its larval and pupal stages is very readily killed by a much lighter dose of gas than is commonly used against the black scale in California; in fact, our field practice with tents demonstrated that we could reduce it about one-half; that the time should be about forty minutes; the variation in temperature ordinarily encountered in Florida seems to be a neglectable factor; moisture did not seem to interfere greatly with the efficiency of the work, unless the

leaves were almost dripping, when it became a factor of much disturbance, though not so great as we had thought probable.

Trees were fumigated in the field in warm sunshine, at all hours of the day, in cloudy weather and at night. We observed but little injury to trees or foliage if fumigated at night, during cloudy weather, early in the morning or late in the evening. Trees fumigated after 9 a. m. and before 4 p. m. in sunshine were invariably somewhat injured, some of the younger limbs dying back and all of the leaves usually shedding. The fallen leaves were all replaced by new growth in a few weeks and no permanent injury done, but the crop upon such trees was noticeably reduced. The dropping of leaves from a tree in Florida has comparatively little significance, the trees, instead of dying, as they sometimes do in California, putting on new foliage and going along as if nothing special had happened. However, the burning of limbs and injury to bloom is another matter, and, therefore, midday fumigation can hardly be practiced. While some defoliation occurred with trees fumigated at other times than midday, even after night, it was not strikingly noticeable, nor was damage to limbs or crop of sufficient amount to be detected after a few months. Some of this work was done as late as February 18, when the blossoms were beginning to open, some of them being well expanded. The bloom seemed unaffected by the treatment unless the work was done with the sun at high meridian.

The white fly seemed practically exterminated upon the treated trees. In examining hundreds of leaves from dozens of trees about ten days after they were fumigated, and covering thousands of insects, I was able to find but a single living specimen. If a grove was segregated from all others, I have no doubt that one fumigation would render it so nearly clean that it would need no additional attention for two or three years. The great hindrance to its becoming a practicable remedy is that but few groves are so isolated that the fly will not come to them from neighboring groves, and since the insect seeks young and tender growth for egg-laying purposes, there is, perhaps, some tendency for it to go to trees that have been fumi-

gated and are therefore putting out new growth. Under ordinary circumstances, the insect is not a great traveler, though winged, and will often take a whole season, extending over three full broods to spread over a ten-acre grove; its progress will be marked by the trees showing sooty mold.

Special observations were made to determine the effect of the gas upon lady-bugs. On the afternoon of January 22, seventy-two lady-bugs, almost all *Chilocorus bivulnerus*, which had fallen to the ground under fumigation treatment, were placed in a shallow tin box and left until January 23; at 9:30 a. m. of the latter date seventy beetles were in the box, a few of them active; at 4 p. m. sixty-six remained in the box, about a dozen of them showing signs of activity. At 8:45 a. m. January 24, sixty-two lady-bugs were in the box, and sixty at 12:40 p. m.; the sixty never exhibited signs of animation, all being observed to be dead several days afterward. January 24, by 1 p. m. another lot of one hundred-seventy-one fallen bugs, nearly all of the same species as before, was collected and kept in the same manner as the first ones. January 25 at 4:30 p. m., one hundred-sixty of these were dead, sixteen out of the lot having recovered. In the first lot, sixteen per cent. of the whole revived, in the second lot about nine per cent.

Since fumigation does not destroy fungous growths many growers will prefer giving it a trial before using a caustic spray.

No matter what style of tent is used, when it is in position a few shovels-ful of earth are thrown on the bottom to hold it in place and render it gas-tight around the base. The generating vessel is set under it, as near to the tree trunk as possible, and the water is poured in, then the acid; the dose of cyanide, wrapped in paper, is next dropped into the vessel and the operator, carrying the edge of the tent with him on his back, quickly steps away, holding his breath and letting the tent fall into position as he does so. A shovel-ful of earth is then thrown upon that part of the tent border just dropped and everything is left undisturbed for forty minutes.

The following table shows the amounts of chemicals used for different sized trees by the Horticultural Commissioners of

Riverside County, California. These amounts are intended for the destruction of scale insects and can be reduced fifty per cent. or more in quantity if it is not specially desired to kill other insects than white fly :

Height of Tree.	Diameter of Tree.	Water.	Cyanide C. P. (98 per cent).	Sulphuric Acid, (66 per cent).
Feet.	Feet.	Ounces.	Ounces.	Ounces.
6	4	2	1	1
8	6	3	1½	1½
10	8	5	2½	2½
12	14	11	5	5½
16	16	17	8	9
20	16-20	22	10	12
20-24	18-22	30	14	16
24-30	20-28	34	16	18
30-36	25-30	52	24	28

The cost of fumigating trees, labor included and not considering the cost nor wear of the tents, is about equal to the cost of giving the same trees three sprayings with resin wash. Low, squatty trees, such as are grown on *C. trifoliata* stocks, with their branches hanging to the ground, are of the shape that should be sought when it is intended to fumigate them regularly.

The precautions to be observed in handling the chemicals are given in the succeeding section on nursery fumigation work.

The Nursery Situation.

No provision is made by the State for the inspection of nurseries, hence there is no way of officially determining their exact status throughout the State. My knowledge of their condition must necessarily come through chance channels and the information I receive is often too unreliable to warrant any public statement regarding it. The reputation of the respective nurserymen for reliability of statement, care in handling their goods and the general condition of the neighborhood in which they are located are the only guides that can be depended upon in choosing from whom to purchase. The safest practice for all

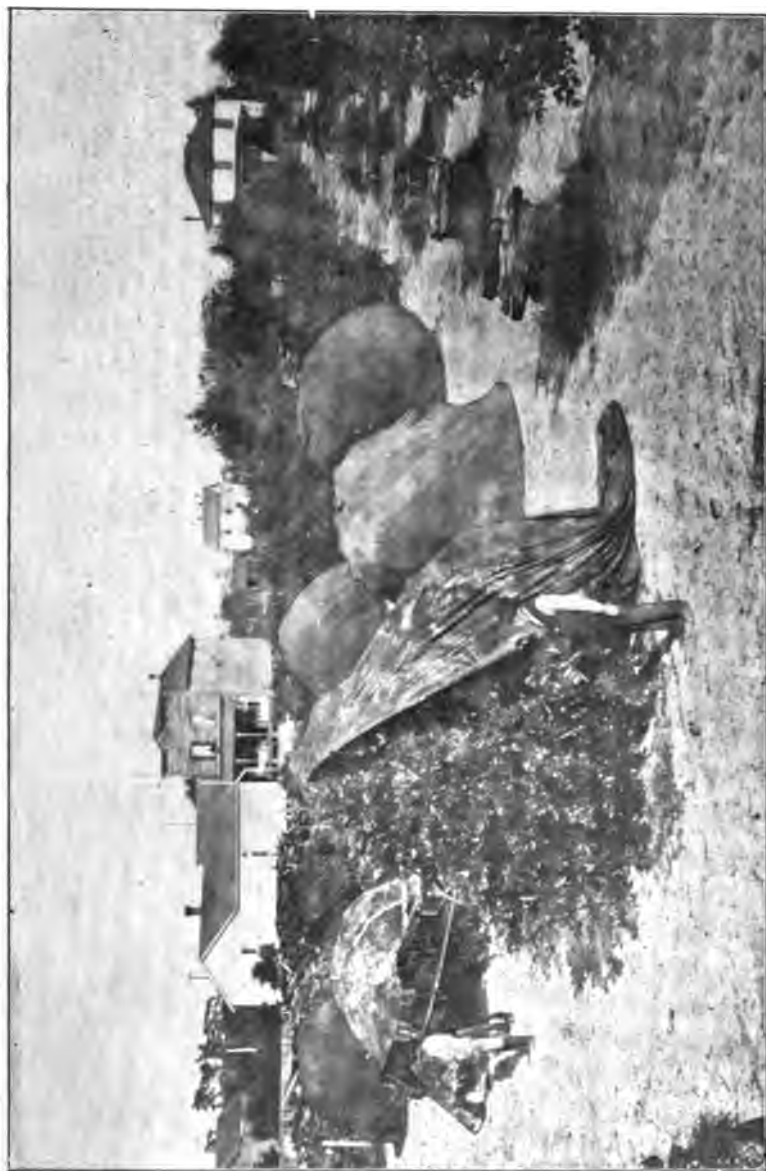


PLATE IV.

FUMIGATING WITH HOOP TENTS AT CANDLER, FLA.

1700

parties, customers and nurserymen alike, will be to handle, in the future, only stock that has been defoliated and cut back. I believe that citrus stock prepared in this way is safer from white fly than is inspected and fumigated peach stock from scale, when shipped from a San Jose scale neighborhood. When fumigation with hydrocyanic acid gas is added I regard the protection as perfect. Fumigation should always be practiced during the spring and summer months and is best never omitted. If stock is shipped during spring or summer, every vestige of leaf should be carefully cut away so as to make certain that no unhatched eggs remain, since these are not readily destroyed by fumigation. Fumigation is undoubtedly effective in destroying the adults and larvae. Dipping and even soaking infested leaves for considerable periods of time in tobacco decoction, Rose-leaf Insecticide, Good's Potash Whale Oil Soap No. 3, Good's Potash Tobacco Soap No. 6, Leggett's Whale Oil Soap Compound and resin wash have been tried, but without satisfactory results. The odor accompanying most of these washes is objectionable and even when the leaves are left immersed in them for considerable periods of time, protected larvae escape injury; thus a leaf with a blister or cavity produced by scale or red spider which was netted over with a spider's web and threads of the sooty mold was submerged for ten minutes in a solution of Good's soap No. 3, one pound to two gallons of water, without killing the larvae sheltered beneath the web as shown by an examination made 72 hours later.

To determine the dose of potassium cyanide (KCN) necessary to give the correct amount of gas to kill the white fly larvae in an air-tight fumigatorium, I commenced by using one gramme of KCN to 15 cubic feet of space for thirty minutes time. An examination made three days later revealed that about 47 per cent. of the larvae had been killed. One gramme of KCN used for 11, 9 and 7 1-2 cubic feet, respectively, for the same length of time showed constantly decreasing percentages of living larvae. One gramme of KCN to 6 1-2 cubic feet of space allowed but one larva out of many that were examined

to come through alive. One gramme to 6 cubic feet seemed to kill everything but to make the dose more certain one gramme to 5 3-4 cubic feet was adopted as the standard dose and has been repeatedly tried, always giving the uniform result of killing all larvae and adults. This dose requires about 17 grammes or 3-5 of an ounce of KCN for every 100 cubic feet of space, or 170 grammes, that is about 8 ounces, Avoir., for every 1,000 cubic feet of space.

The following experiment was made to determine the effect of fumigation on the true eggs. A potted lemon bush, entirely free from white fly, was confined under a cheese-cloth cover and several hundred adult flies were captured and liberated inside the cover. At the end of 48 hours the leaves were covered with thousands of eggs, several hundred of them occurring on each of several leaves. The bush was then fumigated for thirty minutes with the standard dose, or one gramme of KCN to each 5 3-4 cubic feet of space enclosed. The bush was then kept in an unused recitation room, into which no adult fly could possibly enter by accident. After three weeks it was found that about 5 per cent. of the eggs had hatched and the larvae had set upon the leaves. As there could be no possible error as to each egg having been subjected to the gas it is evident that a stronger dose is necessary to kill them. Had the plant been left in full sunshine it is probable that a yet larger percentage of the eggs would have hatched. The bush was severely burned by the gas and it appears that the yet undetermined dose which is necessary to make certain the killing of the egg, is equally certain to damage citrus plants. During the period of heaviest nursery shipments from December 15 to the 1st of March, there are no unhatched eggs, hence no danger exists because of them during this period. Since the eggs are never laid elsewhere than upon the leaves, defoliation and cutting back of the terminal growth removes all possibility of danger from unkilld eggs at all times.

No citrus leaves from an infested nursery should be allowed to get into the moss used in packing. Such leaves could hardly be a source of danger except when harboring well

grown larvae or pupae but, as before mentioned, both larvae and pupae will live for several days upon detached, drying leaves in the laboratory; and if they were packed in damp moss it is very probable that nearly matured ones would issue as adults even as long as three weeks or a month after they were packed.

This spring two lots of trees, six in each, infested with white fly larvae, were fumigated with the standard dose of KCN and set upon the Station grounds without being defoliated; most of the leaves fell as a result of the fumigation but a few adhered carrying the dead larvae. No white fly developed on these nor was there any injury to the stock apparent, due to the fumigation. Another dozen similar trees, not fumigated and planted out at the same time, held a fraction of their leaves, the white fly appearing upon them at the regular time.

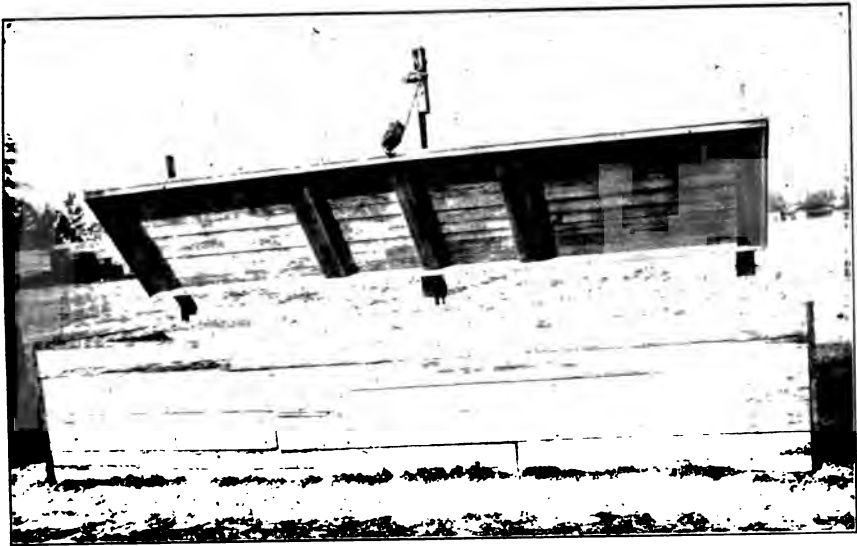
My fumigating box has never been packed full of stock with the foliage remaining upon it and it may be doubted if the dose I use is sufficient to kill all larvae under such circumstances; but I think there can be no doubt that in case it were filled as full as possible of defoliated stock all chance larvae present would be killed.

The accompanying photograph shows a fumigating box of similar pattern to the one in use on the Station grounds. It consists of an inside and an outside box, with an intervening space of six inches filled with sand. The outside box needs no floor but the inside one should be floored to prevent partial absorption of the gas by the moist, earthen floor. The lid which is hinged and lifted by means of double blocks and pulleys is made of two thicknesses of wainscot or flooring with a layer of raw-hide building paper between. Two good coats of lead and oil paint should be applied to the cover inside and out. An air-tight joint is secured between the cover and the box by running around the under side of the cover, which overlaps the edges of the inside box, a pine strip, 2 inches in depth, which thus dips down into the sand. It is best to have a small door about 1 foot square in the bottom of the box, on one side and as

near the center as possible. This door furnishes safe means for introducing the chemicals; its edges should fit against a cushion of felt or burlap; it is tightly pressed against the cushion by some form of sliding wedge driven into place by a smart rap with a hand mallet. If a slatted platform is constructed six or eight inches from the floor to support the plants, the gas being generated below it, diffusion will be comparatively uniform and results with both trees and insects more satisfactory than can be otherwise secured. A tight box-hood should cover the upper half of the generating box which is a foot in each of its three dimensions, the lower half of it being left open, thus forcing the gas out beneath the slatted floor.

The following dimensions will give a box of 99 cubic feet capacity (practically 100 cubic feet) which will be one of the most convenient sizes. Length of the inside box, 11 feet; width, 3 feet; height, 3 feet. Length of outside box, 12 feet; width, 4 feet; height, 3 feet.

To charge the box with gas, fill it with the trees to be fumigated and close down the lid; if the sand is not sufficient in quantity, fill in enough to make a tight joint certain. Now through the trap door introduce into the generating box the generating vessel, which should be of earthenware, China or glass—a glass fruit jar will do; with a glass graduate, measure out in liquid ounces a number of ounces of sulphuric acid (H_2SO_4) greater by half than was used of ounces of cyanide, or in this case, add to 3.5 ounce equal .6 ounce, 1-2 of itself, or .3 and 9-10 liquid ounces is obtained as the correct amount of acid. Of water, use 1-2 more liquid ounces than of acid; in this case, 9-10 plus 1-2 of itself equals .9 plus .45 equals 1.35 or 1 1-3 ounces (nearly). First pour the water in the generator, next the acid. The cyanide should be weighed out beforehand and kept, each dose wrapped in paper, in an air-tight receptacle. The dose, paper and all (use as little paper in wrapping as possible) is dropped into the water and acid, the door being immediately closed and wedged into place. After remaining closed for 30 minutes the upper lid is raised. The residue in the generator consists of sulphate of potash, sulphuric acid and



OPEN.



CLOSED.

PLATE V.
FUMIGATING BOX.

Mod

water; should it come in contact with the skin or clothing, it will corrode and is best buried in the ground when the generating vessel is emptied. *It should never be forgotten that cyanide of potassium is a most deadly poison* and that a very minute particle of it introduced into the mouth will cause immediate death. It is best to use forceps in handling it; never allow it to touch cuts or open sores on the hands. It should be kept away from children and uninformed persons. The gas is the deadliest known, and while no fatalities have ever attended its use as an insecticide, such have occurred in chemical laboratories, and the greatest caution should be observed in working with it. For fuller information concerning fumigating appliances and methods of procedure, the reader is referred to Prof. W. G. Johnson's *Fumigation Methods*, published by the Orange Judd Co., New York.

Insects Sometimes Mistaken for White Fly.

Lecanium hesperidum Linn.—The immature stages of this insect are perhaps more easily, or, at least, are more frequently mistaken for white fly than any other species. The flat, oval scale upon the leaf so nearly simulates the larva of white fly that the ordinary observer is quite excusable in being deceived at first sight. However, the *Lecanium* is more elongated than *Aleyrodes citri* and, relatively, it broadens much more distinctly towards the posterior extremity. The length when full grown is more than twice that of the mature white fly larva, the width being not quite double that of the latter. The body is distinctly notched inward at the posterior end, a formation differing from that in case of white fly. The young are found on the stems and tender branches of various plants (a position never occupied by white fly larvae so far as I have been able to discover) as well as upon the leaves. When upon the leaves, the young tend to range themselves beside the mid-ribs and principal veins, a habit which again disagrees with that of *A. citri*. The scale is commonly spoken of as the turtle-back or soft scale. The dorsal skin may be called yellowish or red-

dish brown, inclining to dark, in some specimens almost to a shining black toward the center. This insect agrees with white fly in causing an excessive growth of sooty mold upon its host plants. (Plate I, fig. 11.).

Nearly related species of *Lecanium*, such as *L. oleae* (Oleander is one of its common food plants) are found on various plants, being always followed by sooty mold.

Aleyrodes floridensis Quaintance.—The Guava white fly is found sparsely upon orange. It is a smaller insect than *A. citri* and the larva is surrounded by a fringe of glassy, waxen rods, conspicuous enough when once noticed, but not readily observed unless looked for. The insect does no damage to orange. It has been collected from many parts of the State upon guava, which it infests seriously, and several years ago Prof. J. H. Comstock collected it at Arcadia, Fla., on "alligator pear."* A few weeks ago it was sent to me from Arcadia by Mr. E. A. Thomas, taken from orange trees that had been planted out, according to his statement, for one year. There can be no reasonable doubt that the insect went to his trees from guavas or "alligator pears" in the neighborhood. (Plate I, fig. 8.).

Ceroplastes floridensis, the white wax scale, often causes patches of gallberry bushes to become very black with sooty mold, the appearance frequently being ascribed to the presence of white fly.

Aphis and many other insects which secrete honey dew and hence are followed by sooty mold have been supposed at one time or another to be white fly.

The papaw white fly, *Aleyrodes variabilis*, has been received once or twice under the supposition that it was the orange white fly. Several species of *Aleyrodes* may be readily mistaken for it.

*Bulletin U. S. Dept. Agr. Division of Entomology, Technical series No. 8, (1900) p. 27.

The Outlook.

As already indicated, the insect is known to be established in fourteen different counties in the State. I have reasons for thinking that it occurs in several other counties than these, but no resources are at my disposal to make a thorough inspection of the State and determine authoritatively its exact distribution. I feel sure that within two years more every neighborhood that was infested before the freeze will discover that it is still infested. Where the insect has become well established by three or four year's of breeding it is well nigh or quite impossible to exterminate it. It is seldom discovered until four or five years have elapsed after its introduction, that is, not until measures of extermination are very apt to prove futile. At the time of discovery it will appear to be confined to a small area, in most cases from a few bushes or trees to a quarter of an acre, but in reality it is sparsely scattered over a territory having a radius of from a quarter to a half mile from the center of infection. I have proved this too many times to be deceived; yet many groves and yards in a town may be infested for several years without the insect's finding its way into groves not more than a mile or two from town.

With the habits of the insect well known and its distribution once authoritatively established, its spread over the State could be greatly retarded but not finally prevented. Fifteen or twenty years may yet remain before the insect will have found its way into every neighborhood in Florida, but this it will certainly do in time. This certainty of eventually getting it should cause no indifference, discouragement or carelessness on the part of any neighborhood or individual; rather ought it to determine everyone to postpone the evil day as long as possible. Five, ten or fifteen years of immunity from the fly, with consequent bright, early maturing fruit of high quality, when competition with other parts of the world will be close and a large part of Florida handicapped because of the insect, is a reward well worth the price of a diligent and persistent lookout to obtain. Special caution should be observed to receive no improperly pre-

pared nursery shipments from any suspicious quarter; and when the insect appears in any neighborhood the preceding section of this bulletin upon methods of dissemination should be carefully studied and the suggestions there given to restrict its spread should be put into practice at once.

Will the orange business be ruined by the insect? No, certainly not; granting that ten years from now the State will receive three-fourths of a million or even a million dollars less per annum than it would receive if the insect were absent, Florida oranges can still be grown at a profit as has been proved by numerous growers through many years of trial. If groves in the heart of the present white fly districts are quoted at prices but little if any lower than if they were located outside of them, they will continue to be paying holdings there and elsewhere, notwithstanding the presence of the fly. No insect of this nature has ever withstood the skill of man in the end, destroying a great industry, and white fly is not so difficult to control as many believe. Natural enemies, restoring Nature's balance, will appear in time, and until then the various means of control already known will be employed by an increasing number of growers. Legislation could be helpful in certain ways, chiefly in increasing the resources of the Entomological Department for experimental work and thus enabling it to introduce the important diseases of the insect into such sections as do not at present have them. The establishment of quarantine regulations would be of questionable utility unless an appropriation of sufficient magnitude were made to maintain a large force of inspectors, and the exercise of all possible vigilance on their part would still be less effective than the simple observance by every purchaser of the recommendations embodied in this publication. So far as the grove problem is concerned, as previously observed, the sentiment of our people is sharply divided regarding wise insecticidal practice, and, until it can be united, the enforcement of prescribed methods of treatment by State officials could only be a source of friction and irritation. Those who believe that treatment of all infested groves should be enforced by law should become home mission-

aries for the next few years, satisfying the majority of their neighbors that such treatment pays,—a task which I believe can be readily wrought by two or three seasons of practical demonstration with spray pump or fumigating tent.

The ultimate distribution of the fly will be over all the Gulf States northward to an isothermal line running somewhere through northern Georgia and westward; California is very likely included in the infested territory now, but it is in the moist gulf regions that the depredations of the insect are to be feared. Citrus fruits will be profitably produced, notwithstanding its presence, wherever climatic conditions are suitable.

Acknowledgments.

In the prosecution of this investigation I have freely consulted the writings of Riley & Howard, Webber, Morgan, Woodworth, Quaintance and others. Valuable information and suggestions have been given me from time to time by Mr. A. J. Pettigrew, Prof. H. H. Hume, Prof. C. W. Woodworth, Mr. F. D. Waite, and others too numerous to mention. The drawings for plates 1 and 2 were made by Miss L. McCulloch, under my supervision. The drawings for plate 6 were made by Prof. Cockerell. The negatives for plates 4 and 5 were taken by me and the prints were made by Prof. Hume. The first three figures of plate 3 are wholly the work of Prof. Hume, while Fig. 4 of the same plate is credited to Prof. H. G. Dorsey.

Summary of Important Facts and Recommendations.

1. White fly, an insect of unknown origin, is probably our worst orange pest where it now occurs. It is known to be established in 14 counties in Florida and probably exists in a number of others.

2. There are three annual broods of the insect of which the first two broods of adults, one occurring in March, April and May and the second in June, July and August, respectively, are well defined and distinct; the third brood occurs in greatest

numbers in September and October, its time limits being poorly defined. The insect shows a tendency to continuous breeding during the last half of the year.

3. The eggs are laid only upon the leaves and the young are motile for a few hours after hatching. When wandering ceases, the larvae fasten themselves to the under surfaces of the leaves and imbibe the sap, at the same time covering the upper surfaces of the leaves vertically beneath them with a coating of honey dew in which a smothering, black, sooty mold develops.

4. The fruit is delayed several weeks in ripening and its sugar and acid content is much reduced; it becomes covered with black mold, necessitating hand or machine washing to prepare it for market, and its carrying qualities are often much injured by such preparation. The annual loss inflicted on the State amounts to hardly less than a quarter of a million dollars and will increase unless the insect is fought.

5. The insect is scattered by nursery shipments, by wind currents, by being carried in covered vehicles, in railway coaches, etc. The motile young may become entangled in the feathers of birds and adult flies are undoubtedly occasionally carried by the same means.

6. White fly has few insect enemies, but two fungous diseases are very efficient in suppressing it under favorable conditions. In close planted groves, surrounded by hammock woods near the coast, these diseases are depended upon wholly by some growers in South Florida to control the insect. It does not become so numerous in open planted groves upon high pine land.

7. Spraying against the white fly is not often abandoned by growers who have once tried it. The most favorable time for spraying is during the winter larval period. At least two thorough sprayings should be made during the winter. Summer spraying is sometimes useful but the materials should be carefully chosen.

8. Resin wash is a very satisfactory spray for winter use but should not be used while the fruit is young. A potash whale

oil soap spray may be safely used, at proper strength, any time except when the trees are in bloom. Kerosene emulsion, caustic soda solutions of sulphur and salt, Thrip Juice and Montgomery's insecticide are all useful to a certain extent and will be sometimes chosen according to the personal preferences of the grower. There seems to be a general and well founded opinion that a good potash whale oil soap is less apt to cause injury to the tree than most insecticides.

9. Fumigation of infested groves is effective and sometimes useful, but at present can only be recommended for use in particular instances.

10. Infested nursery stock is rendered wholly safe by being defoliated, cut back and properly fumigated.

11. The insect will eventually spread over the entire citrus belt but its march can be greatly retarded by care in purchasing and by vigorous repressive measures where it is already established.

THE NEAREST RELATIVES OF WHITE FLY.

In response to an inquiry addressed to Prof. T. D. A. Cockerell, formerly connected with the New Mexico Experiment Station and at an earlier time Stationed in Jamaica with the Imperial Department of Agriculture for the West Indies, he kindly offered to make the comparative study here given of *A. citri* and its allied forms, thinking such a study might throw some light on its origin. The recognized standing of Prof. Cockerell as a comparative anatomist and the large amount of information in his possession relating to this family of insects gives instant interest to anything written by him on such a question. Whether or not his conclusions ever prove to have been correct, since they direct the attention of entomological workers in other parts of the world to the subject, thereby making possible the discovery of the insect's original home, the thanks of Florida are due him for his effort.

THE WHITE FLY.

(Aleyrodes citri) AND ITS ALLIES.

BY T. D. A. COCKERELL.

The genus *Aleyrodes* (often spelled *Aleurodes*) was first distinguished and named by Latreille in his "Histoire Naturelle des Crustacés et Insectes," Vol. XII. p. 347. In this work published in 1804, there is given a description of the genus, the type of which is the *Tinea proletella* of Linnaeus. This species, which lives in Europe on leaves of *Chelidonium majus*, was made the subject of an excellent memoir by Reaumur (Mem. Ins., Vol. II, pp. 302-317, Pl. XXV, figs. 1-7), and consequently was quite well known at the time of Latreille's publication, though it had been erroneously placed among the Lepidoptera.

A close ally of this *A. proletella* is *A. brassicae*, Walker, 1852, which occurs on cabbage. This is said to be hard to distinguish from *proletella* in the adult, but the larva (pupa?) is long, while that of *proletella* is round-oval. In 1868 Signoret published a revision of the then-known Aleyrodidae, describing seven as new. Most of the species were European, but two were known from Chili, two from the United States, and one from Mauritius. In 1896 Maskell (Trans. New Zealand Institute, XXVIII.) gave a list of all the Aleyrodidae known at that time, numbering 66. Of these, 22 were described as new.

Character.

The adult Aleyrodidae are small, four-winged insects, very similar to one another, except for the fact that some have the wings variously spotted and banded. The pupae, however, present very strong distinctive characters, and are largely used in classification. These pupae are small, oval objects attached to

leaves, usually to the lower surfaces, and in general resemble the smaller kinds of scale-insects. Under a compound microscope one is able to see certain characters which greatly assist in the identification of Aleyrodid pupae. On the back toward the hind end, is an orifice of a more or less triangular or rounded shape, known as the *vasiform orifice*. In this is seen a lid-like structure, the *operculum*, and a more or less tongue-like object, called the *lingua*. The margins of the pupae are also variously sculptured, and offer good characters.

With a lens, one notices the color, shape and convexity of the pupa, and the character of the waxy secretion, if any. This secretion covers the whole pupa, but more often it forms a fringe around the sides.

Divisions of the Aleyrodidae.

At present, only two genera are recognized in the family. *Aleyrodes*, Latreille, includes the great majority of the species, these having the main vein of the wings not bifurcated towards the end. In 1892 Douglas separated the genus *Aleurodicus* which contains those species having the main vein of the wings bifurcated. This is a perfectly valid distinction, but care must be taken not to mistake a fold which often occurs in the wings of *Aleyrodes* for a branch vein. It has not been considered that *Aleurodicus* can be distinguished from *Aleyrodes* by the pupa, but I believe it has sufficient characters in this stage also. These are found in the short, broad operculum, combined with a very large lingua, which has two or four bristles at its end. The pupa also has large submarginal orifices, especially in the abdominal region, and the margin is likely to exhibit bristles at rather distant intervals.

Having regard to these characters, I believe that the following, hitherto referred to *Aleyrodes*, may be safely transferred to *Aleurodicus*.

(1.) *Aleurodicus altissimus* (*Aleyrodes altissima*, Quaintance, tom. cit p. 20.)

(2.) *Aleurodicus perseae* (*Aleyrodes perseae*, Quaintance, tom. cit., p. 32.)

(3.) *Aleurodicus holmesii* (*Aleurodes holmesii*, Maskell, tom. cit., p. 435.)

All the species of *Aleurodicus* belong to the warmer parts of America (North and South), except *A. holmesii*, which is from Fiji. I suspect that the latter was introduced into Fiji from South America, along with the guava (*Psidium*) on which it lives.

Although *Aleyrodes*, after excluding *Aleurodicus*, includes a great many diverse types, it has not yet been subdivided. An examination of the vasiform orifice, lingua and operculum brings out the following facts:

(1.) There is a group, apparently exclusively American, in which the orifice is rather elongated, and the lingua is long and narrow, and usually strongly crenulated. This includes such forms as *A. erigerontis*, *A. nicotianae*, *A. vittata*, *A. variabilis*, *A. pergandei*, *A. fitchi* and *A. ruborum*.

(2.) A small American group, allied to this, has the lingua enlarged distally, with a distinct terminal joint. This includes *A. pergandei*, *A. fitchi* and *A. ruborum*.

(3.) A third American group, found principally on the oak, has the pupa very dense, quite black, with the orifice elongated. The margin of the pupa is peculiar, and there is a white waxen fringe. *A. melanops* (figs. 2, 3, 4) and *A. perileuca* (fig. 5) are examples.*

(4.) There is a group of the Old World, from India to New Zealand, in which the orifice is usually short, sometimes broader than long, and the lingua is much abbreviated. Examples are *A. cotesii* (India), *A. croseata* (Australia), *A. eugeniae* (India), *A. aurantii* (India), *A. fodiens* (New Zealand) and *A. piperis* (Ceylon).

Aleyrodes perileuca, n. sp.—Pupa perfectly black, 1250 micromillimeters long, of the usual oval shape, with a very narrow regular fringe of straight white waxen ribbons, about 100 micromillimeters long. A sharp, elevated, submarginal keel; dorsum strongly longitudinally keeled, the abdominal portion with transverse ridges making the segments. The dorsal keel in the thoracic region is sharp, but in the abdominal region it is broad and rounded, with its surface irregularly tessellate, and is crossed by six transverse narrow antero-posteriorly corrugated bands. Vasiform orifice shovel-shaped. Marginal area with very

Other groups are suggested by various species, but do not seem to be so clearly defined. Curiously, *A. floccosa* and *A. stellata*, from Jamaica, seem to be related to the Australian series of *A. stypheliae*, *A. nigra*, *A. limbata*, *A. hirsuta* and *A. banksiae*.

Aleyrodes Citri.

The white fly, or citrus mealy-wing, was described in detail, with excellent figures, in *Insect Life*, Vol. V, (1893) pp. 219-226. Unfortunately, however, the detailed characters of the pupa were not given in such a manner as to permit adequate comparison with other species. Prof. H. A. Gossard has kindly supplied me with abundant material on leaves of Cape jessamine (*Gardenia*) from Florida, and I am able to give diagrams of the pupa (fig. 7) and of the vasiform orifice (fig. 6). It will be seen that the vasiform orifice is broader than long, and the lingua is short and broad. These characters are not those of the typical American groups, but agree well with the Asiatic group, No. 4 above.

On examining the other characters of the pupa, we find three deep furrows (fig. 7, a,a,a, and A.), one on each side, and one at the caudal end. At the distal end of each furrow is a somewhat star-shaped opening. Such structures as these I find described only in two species, namely, *A. eugeniae*, Maskell, tom. cit., p. 430, and *A. aurantii* (*eugeniae* var. *aurantii*, *Mas-aurantii* (which appears to be a valid species) occurs abundantly on leaves of orange in the northwest Himalayas.

numerous regular radiating furrows, the areas between them minutely punctured. Margin very regularly crenulate. No dorsal section whatever. The conical black larval skin was found in one example on the back of the pupa, but ordinarily it falls away.

Hab. Solitary on the upper side of leaves of live oak; Cuero, Texas, June 2, 1898. (C. H. T. Townsend); La Jolla, San Diego Co., California, Aug. 1901, (Cockerell).

Aleyrodes melanops, n. sp.—Pupa black, similar in structure to *A. perileuca*, but larger (about 1.1-2mm. long), broad-oval, with the white fringe much longer and curled over, so as to be strongly convex above.

Hab. Solitary on the upper side of leaves of oak (*Quercus*), at Alpine Tavern, Mt. Lowe, California, Aug. 1901, (Cockerell.)

The Original Home of *Aleyrodes citri*.

I believe that *Aleyrodes citri* is a native of China or some neighboring country for the following reasons:

(1.) It's affinities seem to be wholly with an Asiatic and Australasian group, and particularly with a species found on orange in the Himalayas.

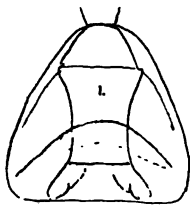
(2.) Orange trees have been brought to Florida from China, and the *Aleyrodes* would be very easily carried with them.

(3.) Florida has had, at least as long as the *Aleyrodes*, two scale-insects of the orange, which are almost certainly Asiatic and very likely Chinese. These are *Parlatoria pergan-dei* and *Mytilaspis gloveri*. These were probably brought over at the same time as the *Aleyrodes*.

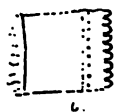
(4.) *A. citri* occurs also on the Cape jessamine (*Gardenia florida*), which is a native of China.

(5.) *A. citri* multiplies excessively in Florida, indicative that it is probably not American. The American species of *Aleyrodes* are not commonly harmful. In Arizona I found an *Aleyrodes* of a native type living upon the oranges but it was not doing any harm or multiplying excessively. This insect (described in *Science Gossip*, May 1900, p. 366,) appears to be only a variety of *Aleyrodes mori*, Quaintance. It may be called *A. mori* var *Arizonensis*.

[In the article just cited, owing to an editorial blunder two paragraphs are run together, making nonsense, page 367, first col., line 14, dele "They are," and begin a new paragraph.]



A spiracular diagram
of variform orifice of
1. lingua



A. melanops. a diagram of
variform orifice and lingua
2. section of marginal area



A. melanops.
enlarged.



A. melanops: section
showing curved marginal
filaments.



A. perileuca, citi.
a variform orifice. L. margin.
(larva) (pupa)

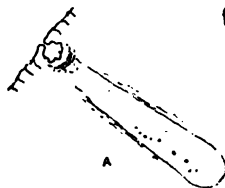


fig. 7.

fig. 6.

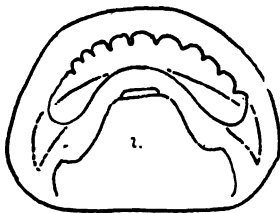
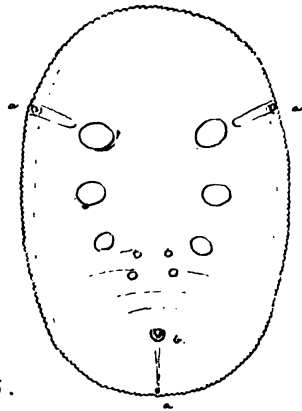


Diagram of variform orifice of A. citi.
1. lingua



A. citi. diagram of pupa
a. a. a. furrow & variform orifice.
A. Furrow enlarged.

1701

BULLETIN NO. 68.

JUNE, 1903.

FLORIDA
AGRICULTURAL EXPERIMENT STATION

Pineapple Culture. I. Soils.



By H. K. MILLER and H. HAROLD HUME.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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*Supt. Farmers' Institutes.

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Pineapple Culture. I. Soils.

Introduction.

The pineapple industry in Florida has become one of very considerable importance. The culture of this fruit on a commercial scale dates back only about fifteen years, and thought comparatively in its infancy, the report of the Commissioner of Agriculture for the year ending December 31, 1902, shows that 6,531,906 fruits (about 340,000 crates) valued at \$717,608.00 were produced during that year. The industry would probably have developed earlier than it did and would undoubtedly have reached greater proportions by this time had it not been that the lack of transportation facilities prevented. It was not until the strip of land along the shore of the Indian River was opened up that the industry was enabled to take a foremost place among the horticultural pursuits of the State.

Notwithstanding, that pineapple culture has become of such importance in Florida, no extensive literature, such as may be obtained on the growing of other crops is available. In consequence, the prospective grower has had, and still has, to fall back upon his own resources or seek information from others engaged in the industry. As a result he has too frequently been left in doubt because of the incongruity in methods advocated by different growers.

To remedy this condition, by placing at the service of the growers prospective or otherwise, a literature commensurate

with the importance of the industry and in an attempt to secure information covering more fully the unsolved problems connected with the production of the crop, an outline of investigation work covering every phase of pineapple growing was drawn up by the writers during the winter of 1901. Since that time the work has been pursued as vigorously as time and equipment would permit.

Much has been accomplished already and following this publication, the ones on varieties, analyses and fertilizers will be issued. Others covering the problems of diseases, insects, marketing, cultivation and other points are in preparation and will be issued as soon as finished.

Work on the present publication was commenced in June, 1901, since which time nearly every pineapple producing section has been visited once and in many cases twice or oftener. In carrying out the work we have been fortunate in securing through Dr. A. C. True of the Office of Experiment Stations, the co-operation of the Bureau of Soils, U. S. D. A., and all the mechanical analyses were made there.

The object in view in undertaking the work was to study thoroughly the characteristics and peculiarities of the different soils, determine if possible, those best adapted to this fruit, and to find out wherein lies their superiority.

All Florida soils adapted to the pineapple plant, at present used for its culture, have been studied, thereby securing data upon which the selection of untried areas may be based.

Method of Sampling.

After preliminary trials, it was finally determined that the most uniform sample of soil could be obtained by means of the

instrument shown in the frontispiece. This consists of a brass tube one and a fourth inches in diameter, forty inches long and about one sixty-fourth of an inch thick. On the inside of the cutting end is brazed a steel tube three-fourths of an inch long, one thirty-second of an inch thick and of such diameter as to fit snugly within the brass tube. This was ground to a sharp cutting edge from the outside.

Upon thrusting the sampler into the ground, to the desired depth, a core of soil slightly less in diameter than the inner diameter of the tube is forced into it and may be removed with the tube when it is carefully withdrawn from the ground. By means of a plunger this core can be shoved out in a solid section for examination or emptied into a sack for a sample. This sampler is not adapted to heavy clay soils, gravelly soils, or those containing rock, but a core the full length of the tube can be obtained from most Florida soils.

The surface soil in every case was obtained by thrusting the tube into the ground to a depth of eight inches. The subsoil was obtained from the same hole by carefully inserting the tube and pushing it down seven inches further. Thus with surface and subsoil together, a core fifteen inches long was removed. For analytical work, these were kept separate, a composite sample made up of three cores being taken for both chemical and mechanical analysis. All samples were taken in duplicate, one being sent to the Bureau of Soils, U. S. D. A., the other being reserved for the chemical analysis at the station. A core of soil the full length of the tube was removed wherever possible and inspected to obtain an idea of the lower subsoil. This could not be done at Miami and in one sample taken at West Palm Beach because the tube encountered rock.

In nearly every locality, samples were procured from both virgin and cultivated soil, and at the same time careful notes were made of the natural plant growth on the virgin soil. With few exceptions, the samples were personally collected by one or both of the writers. Photographs were taken of the native growth and of the growing pineapples, a number of which are reproduced among the illustrations of this publication.

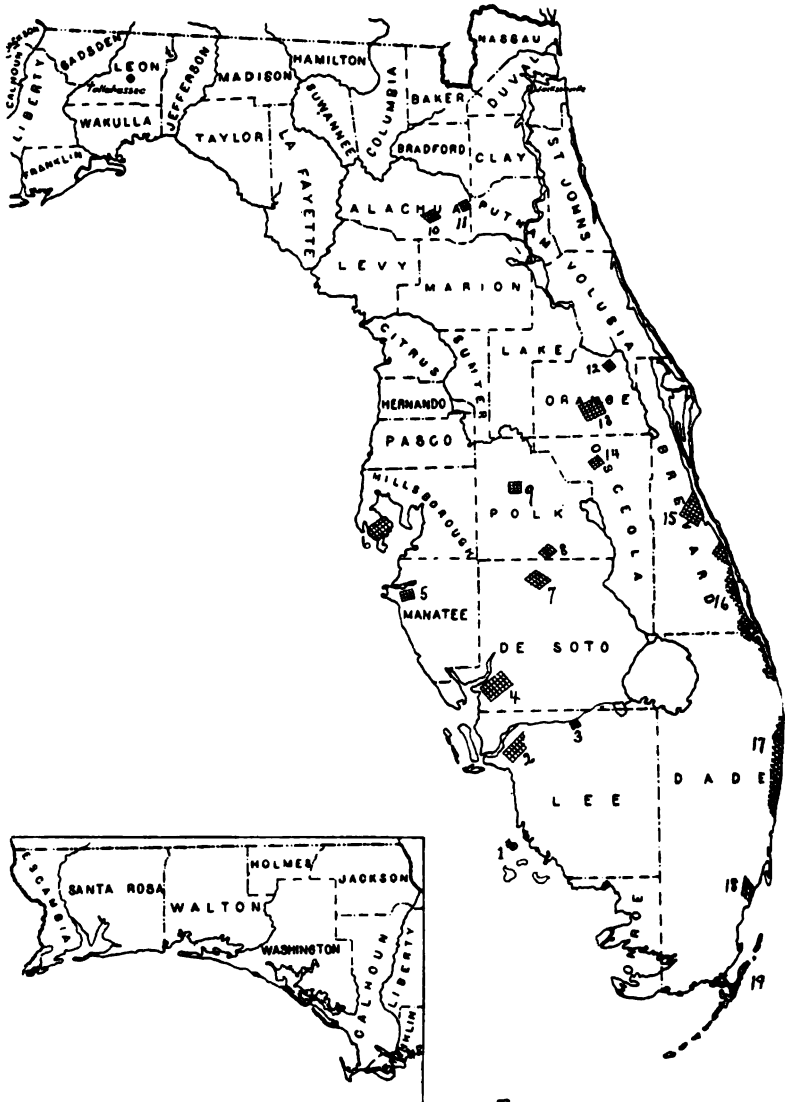
Florida's Present Pineapple Areas.

At the present time, pineapples are grown in a small way in many parts of the State, but not in all of these can the crop be considered to be of commercial importance. Plate I shows most of the points. These are: 1. Caxambas; 2. Myers; 3, Alva; 4, Punta Gorda; 5, Manatee Section; 6, St. Petersburg; 7, Avon Park; 8, Pabor Lake; 9, Winter Haven (a small area); 10, Gainesville (small); 11, Earleton (very small); 12, Sanford; 13, Orlando; 14, Narcoossee; 15, Micco; 16, Jensen; 17, Palm Beach; 18, Miami; 19, Florida Keys.

The report of the Commissioner of Agriculture for 1901-1902 gives the following numbers of pineapples by counties:

Brevard,	3,612,400
Dade,	2,179,150
Monroe,	771,600
Lee	315,800
Hillsborough,	302,076
DeSoto,	164,630
Orange,	153,600
Polk,	20,000
Pasco,	5,450
Volusia,	5,000
Lake,	1,500
Osceola,	700

PLATE I.



WHERE PINEAPPLES ARE GROWN.



Fig. 1. Native growth, Miami.

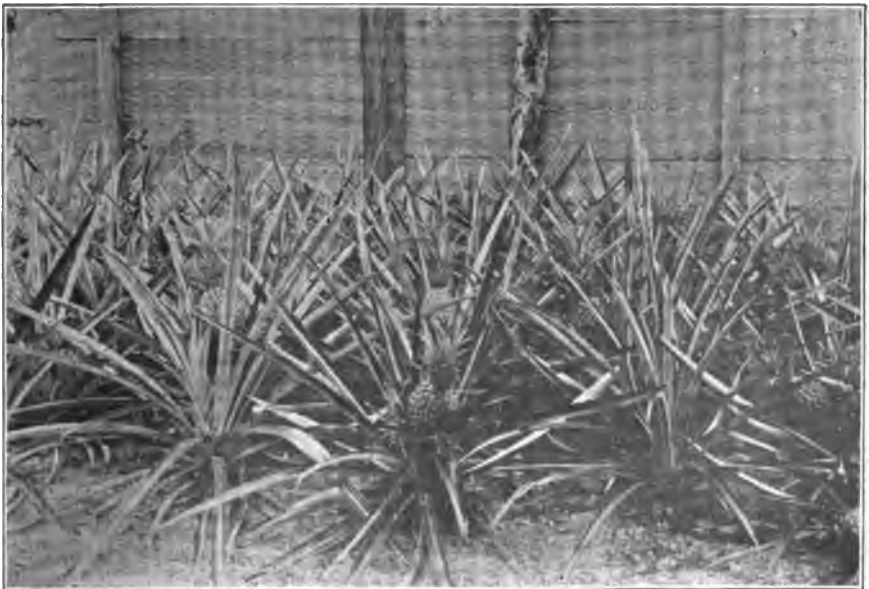


Fig. 2. Pineapples at Miami.

From this it will be seen that pineapples are produced in more than one-fourth of the counties in the State.

Soils, Localities, Characteristic Vegetation.

Samples were collected at Miami, Lemon City, Boca Raton, West Palm Beach, Eden, Eldred, Punta Gorda, Oneco, St. Petersburg, Orlando and on Elliott's Key. There are other sections in which pineapples are successfully grown, but it is believed that every type of soil within the confines of the State at all adapted to their culture is represented by the samples taken in the above localities.

The following notes were made when the samples were collected:

Sample No. 1296. Owner, E. L. Hill. Locality, Miami. Rocky, pine land, (cultivated.)

Notes: Depth to rock, variable, depending upon the conditions mentioned in notes on sample number 1300. Growth of pineapples, fairly good. Plot shedded and planted in Cayennes and Porto Ricos, part three years planted, part newly set. Plants, generally healthy, but with a little blight showing here and there. Fruit, very good.

Sample No. 1298. Owner, E. L. Hill. Locality, Miami. Rocky, pine land, (virgin.)

Characteristic Vegetation.—Cuban pine, (*Pinus Cubensis* Griseb.)* saw palmetto (*Serenoa serrulata* Hook.) coontie (*Zamia integrifolia* Willd.) (*Andromeda ferruginea* Walt) and (*Andropogan* sp.) here and there in small clumps.

Notes: This land is essentially the same as number 1300, but supports a denser growth of saw palmetto.

Sample No. 1300. Owner, Dr. Depuy. Locality, Lemon City. Rocky pine land, (virgin).

Characteristic Vegetation.—Cuban pine (*Pinus Cubensis* Griseb) saw palmetto (*Serenoa serrulata* Hook.) Coontie (*Zamia integrifolia* Willd.) dwarf palmetto (*Sabal Adansonii* Guerns.) A few scrub oaks (*Quercus myrtilolia* Willd.) and devil's shoe string (*Cassia nictitans* L.) growing here and there.

Notes: The growth of pines, sparce, while the saw palmetto is very abundant. The underlying formation of rock is of a somewhat honey-comb structure. The depth of the surface soil depends entirely upon the depressions or holes in the rock, but generally, the solid formation is struck by the sampler at from seven to thirty-six inches. The land is essentially flat, elevated about ten feet above sea level.

Sample No. 1302. Owner, —————, Locality, Boca Raton, scrub pine land (cultivated.)

Notes: Field planted to 750 Porto Rico pineapple plants. Between ninety and one hundred per cent of these plants are blighted. No fertilizer applied since March, 1901. Disease probably introduced by planting unhealthy plants. Quality of land similar to, or practically identical with, No. 1304.

Sample No. 1304. Owner, T. Donnelly. Locality, Boca Raton, scrub pine land (virgin.)

Characteristic Vegetation.—Scrub pine (*Pinus inops clausa* Englm.) scrub oaks (*Quercus virens maritima* Chapm. *Q. stellata parvifolia* Chapm., *Q. myrtifolia* Willd.) crowberry

*Chapman's nomenclature has been followed in nearly all cases.

PLATE III.



Fig. 1. Scrub Land, Boca Raton.



Fig. 2. Pineapples at Boca Raton.

1901

(*Ceratiola ericoides* Michx.) (*Andromeda ferruginea* Walt.) lichens (*Cladonia rangiferina* C. *alpestris* L. *C. rangiferina sylvatica* L., *C. leporina* Fries.) saw palmetto (*Serenoa serrulata* Hook.) and an occasional dwarf palmetto (*Sabal Adansonii* Guerns.)

Notes.—The growth of scrub pine is quite thick and dense but the trees are small, four to six inches in diameter, the undergrowth of scrub oaks, crowberry and saw palmetto, quite thick. The soil showed practically no variation down to a depth of forty inches with the exception of the dark coloration due to the presence of humus in the upper three of four inches.

Sample No. 1306. Owner, Mr. Mathems. Locality, West Palm Beach scrub pine land with some Cuban pine (virgin).

Characteristic Vegetation.—Scrub pine (*Pinus inops clausa* Englm.) scrub oaks (*Quercus virens maritima* Chapm., *Q. stellata parvifolia* Chapm., *Q. myrtifolia* Willd.) crowberry (*Ceratiola ericoides* Michx.) saw palmetto, (*Serenoa serrulata* Hook.)

Notes: The growth of pines is quite dense and the trees large. The scrub oaks are of good size and form a very dense undergrowth. The surface soil shows considerable humus and yellow sand was touched in the subsoil at thirty inches. This piece of land slopes off into a damp saw grass savannah about one hundred yards from where the sample was taken.

Sample No. 1308. Owner, Mr. Mathems. Locality, West Palm Beach pine land (Virgin.)

Characteristic Vegetation.—Cuban pine (*Pinus Cubensis* Griseb.) scrub oaks (*Quercus virens maritima* Chapm., *Q.*

stellata parvifolia Chapm., *Q. myrtifolia* Willd.) saw palmetto (*Serenoa serrulata* Hook.)

Notes: The growth of pines is rather scattered and only a few saw palmettos are seen. The sampler touched the yellow subsoil at fifteen inches.

Sample No. 1310. Owner, H. M. Flagler. Locality, West Palm Beach, scrub pine land, sample taken from a piece of ground which was previously planted to Bermuda grass; the pineapples, in spite of heavy fertilizing, did not make a good growth, being about one year behind those planted on virgin soil. Bermuda grass had grown on the ground for about six years and the pineapples had been planted three years.

Sample No. 1312. Owner, H. M. Flagler. Locality, West Palm Beach, scrub pine land in cultivation.

Notes: This sample was taken from a portion of the pinery which showed a considerable amount of spike. The plants are badly affected, the leaves being slim, narrow and in a very unhealthy condition. The affected area is rather irregular in form. The ground has been set to pineapples three years. Fertilizer used, cottonseed meal and tobacco, low grade sulphate of potash and high grade blood and bone, 10-12 per cent potash, 4-5 per cent nitrogen, 3 per cent phosphoric acid.

Sample No. 1314. Owner, Hardee Bros. Locality, Eden, hickory scrub land.

Characteristic Vegetation.—Hickory (*Carya carolineae septentrionalis* Ashe.) scrub oaks (*Quercus virens maritima* *Q. stella parvifolia* Chapm., *Q. myrtifolia* Willd.) A few scrub pines (*Pinus inops clausa* Englm.) and saw palmetto (*Serenoa serrulata* Hook.)

Notes: This piece of land is located on the face of an elevation to the West of the railroad. The growth of scrub oak is quite dense; the hickories small, due undoubtedly, to their having been repeatedly destroyed by fires within recent years. Surface soil has a liberal admixture of humus; sub-soil, yellow, commencing at a depth of eight inches below the surface.

Sample No. 1316. Owner, Henry Cling. Locality, Eden. Worn out pineapple land, planted to pineapples in '91, thrown out in '94, since which time it has been neglected.

Characteristic Vegetation:—Before being planted to pineapples, this land bore a growth very similar to No. 1318, but since being abandoned but very little native growth has appeared. A few pineapples still persist and scattered here and there may be found mustang grape (*Vitis rotundifolia* Michx.) Prickly pear (*Opuntia* sp.) wandering jew (*Tradescantia* sp.), and a few grasses, among which is a species of *Andropogon*.

Notes: Patches of considerable extent are noted upon which absolutely nothing grows, and the soil seems to be very deficient in vegetable matter. The soil to a depth of thirty inches at least, consists of little more than white sand.

Sample No. 1318. Owner, Hardee Bros. Locality, Eden, Fla., Ag. Exp. Station Grounds, good quality of scrub pine land, oak scrub underbrush with an occasional hickory. (virgin soil just cleared).

Characteristic Vegetation:—Scrub pine (*Pinus inops clausa* Englm.) scrub oak (*Quercus virens maritima* Chapm., *Q. stellata parvifolia* Chapm., *Q. myrtifolia* Willd.) lichens as in No. 1322.

Notes: The surface soil appears to be white sand with a fair admixture of vegetable matter. The sub-soil is dark yellow sand, which commences at a depth of from ten to thirty inches below the surface.

Sample No. 1320. Owner C. T. McCarty, Locality, Eldred. Hickory scrub or hickory land (virgin.)

Characteristic Vegetation.—Hickory (*Carya carolineae septentrionalis* Ashe.) mulberry (*Morus rubra* L.) red bay (*Persea Carolinensis* Nees.) wild coffee (*Psychotria undata* Jacq.) lantana (*Lantana Camara* L.) gumbo limbo (*Bursera gumifera* Jacq.) satin leaf (*Chrysophyllum oliviforme* Lam.) bitterwood or pop-ash (*Simaruba glauca* D C.) cacti (*Cereus monoclono*s D C., *C. triangularis* Haw.) live oak (*Quercus virgens* Ait.), and occasionally cabbage palmetto (*Sabal palmetto* R. & S.) and dwarf mock orange (*Prunus sphaerocarpa* Swartz.)

Notes: This land takes its name from the hickory growth upon it, but many of the trees and shrubs indicated above are very common. In some sections this ground has been frequently burned over. The hickories have sprouted from the roots, giving a dense growth of what would appear to be scrub hickory. The growth is very thick and heavy and it is only with difficulty that a man can make his way through it.

The surface soil contains a great deal of vegetable matter, and shades off beneath to a rather yellowish sand, which appears to contain considerable humus.

Sample No. 1322. Owner, C. T. McCarty. Locality, Eldred, high grade scrub pine land.

Characteristic Vegetation.—Scrub pine (*Pinus inops clausa*



Fig. 1. Hickory Land, Eldred.



Fig. 2. Pineapples at Eldred.

3140

Englm.) scrub oaks (*Quercus virens maritima* Chapm., *Q. stellata parvifolia* Chapm., *Q. myrtifolia* Willd.) lichens (*Cladonia leporina*, *C. rangiferina sylvatica* L., *C. rangiferina alpestris* L.) saw palmetto (*Serenoa serrulata* Hook.) almost entirely absent.

Notes: The growth of scrub pine is quite large, trees frequently reaching ten or twelve inches in diameter, not very dense. Younger growth consists almost entirely of the species of scrub oak already mentioned, dense and thick. At a depth of 30 inches the subsoil appeared to be composed entirely of white sand. The sample was taken from the side of a gentle slope some distance back of the Indian River.

Sample No. 1380. Owner, Isaac Doolittle. Locality, St. Petersburg. Pine land (virgin.)

Characteristic Vegetation:—Rosemary or crowberry (*Ceratiola ericoides* Michx.), black jack oak (*Quercus nigra* L.), live oak (*Quercus virens* Ait.), saw palmetto (*Serenoa serrulata* Hook.), long-leaved pine (*Pinus australis* Michx.).

Notes: Growth rather open, but the trees, particularly the pines, of large size. Soil rather chocolate colored down to a depth of 40 inches.

Sample No. 1382. Owner, Mrs. Ferronds. Locality, St. Petersburg. Pine land.

Characteristic Vegetation:—Long-leaved pine (*Pinus australis* Michx.), upland willow oak (*Quercus cinerea* Michx.), and a little saw palmetto (*Serenoa serrulata* Hook.)

Notes: The soil very similar to 1380 but not so high.

Sample No. 1384. Owner, Reasoner Bros. Locality, Oneco.

This sample was collected by Mr. Reasoner in the same way as the other samples were taken by the writers. His notes on the soil were as follows:

"The sample of soil was from high pine land which had pines, scrub oaks, live oaks, huckleberries, black jack oaks, etc., over it. The sub-soil was almost all sand, not very far down, and moderately fine. Orange trees do remarkably well, as do pines, on it although it is rather too dry for oranges in our extremely drougthy years."

Sample No. 1411. Owner, —————. Locality, Elliott's Key. Typical Key pineapple land.

Characteristic Vegetation:—Gumbo limbo (*Bursera gummi-fera* Jacq.), Lignum vitae (*Guaiacum sanctum* L.) poison wood (*Rhus metopium* L.) dogwood (*Sapindus Saponaria* L. iron wood (*Hypelate trifoliata* P. Browne.), prince wood (*Exostemma Caribaeum* R. & S.) pigeon plum (*Coccoloba Floridana* Meisner), lance wood (*Nectandra Willdenoviana* Nees.) satin leaf (*Chrysophyllum oliviforme* Low.), red stopper (*Eupetes procera* Poit), Gurgeon stopper (*Eugenia buxifolia* Willd.), rubber (*Ficus pedunculata* Willd.), white wood (*Drypetes corcea* Poit.), boxwood (*Schaefferia frutescens* Jacq.) beef wood (*Pisonea obtusata* Swartz.), crab wood (*Sebastiana lucida*), mastic plum (*Sideroxylon pallidum* Spreng.), pop ash (*Simaruba glauca* D C.) wild tamarind, silver palm (*Thrinax argentea* Lodd.) Darling plum (*Reynosa latifolia* Griesb.) and many other trees and shrubs.

Notes: Coral rock, rough and uneven, with many large

holes more or less circular in form, called "pot holes." These are filled with decomposing vegetable matter. In the virgin soil, there is a considerable amount of this substance, sufficient to make the surface comparatively level. After clearing and cultivating for three or four years little is left but the bare rock.

Myers.—Samples were collected on Dr. Brecht's place at this point, but too late for analysis. The following notes were made on the vegetation:

Characteristic Vegetation: Saw palmetto (*Serenoa ser-
mulata* Hook.) scrub oak (*Quercus virens maritima* Chapm.,
Q. stellata parvifolia Chapm., *Q. myrtifolia* Willd.) live oak
(*Quercus virens* Ait.), Cuban pine (*Pinus Cubensis* Griseb.)
found in places. See plate 8, fig. 1.

Notes: The soil is white sand with a fair amount of humus
in the upper four or five inches. No change in character down
to a depth of forty inches. Growth of pines fairly good. See
plate 8, fig. 2.

Sample No. 1386. Owner, Wm. Whitten. Locality, Punta
Gorda, flat woods (cultivated field set in 1900.)

Notes: Dark brown hardpan two feet below the surface
consisting of sand and organic matter, evidently the remains
of an old saw palmetto bed. Plants in rather poor condition.
Bedding has to be resorted to, since the surface is elevated only
three or four feet above mean tide.

Sample No. 1388. Owner, Wm. Whitten. Locality, Punta
Gorda, kind of land, flat woods (virgin.)

Characteristic Vegetation.—Cuban pine (*Pinus Cubensis* Griseb.), and saw palmetto (*Serenoa serrulata* Hook.)

Notes: The first twelve inches of soil, gray, underlaid with ten inches of white sand, then seven to twelve inches of yellow sand and beneath this, hardpan, consisting of a peaty substance derived principally from saw palmetto.

Sample No. 1390. Owner, C. Van Houten. Locality, Orlando; kind of land, flat woods.

Characteristic Vegetation.—The sample was taken from an old field which before clearing, probably supported a growth of long-leaved pine (*Pinus australis* Griseb.), saw palmetto (*Serenoa serrulata* Hook.) and upland willow oak (*Quercus cinerea* Michx.)

The mean elevation of points on the East Coast furnished through the kindness of Mr. J. R. Parrott, are as follows: Miami, 10 feet; Boca Raton, 14 feet; Delray, 16 feet; West Palm Beach, 16 feet; Jensen, 19 feet; Fort Pierce, 22 feet; Eldred, 32 feet.

Information as to the elevation of other sections could not be had in every case, but the following is taken from Bulletin No. 160, U. S. Geological Survey: Manatee, 16 feet; St. Petersburg, 20 feet; Gainesville, 144 to 185 feet; Sanford, 17 feet; Orlando, 98 to 111 feet; Narcoossee, 72 feet.

Chemical Composition of the Soils.

The methods employed in making the chemical analyses of these soils are essentially those given in Bulletin 46, revised edition, Division of Chemistry, U. S. D. A. The figures in the accompanying tables represent the percentage composition of the water free sample.



Fig. 1. Flat Woods, Punta Gorda.



Fig. 2. Bedded Pineapples at Punta Gorda.

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CHEMICAL ANALYSES.

Number	LOCALITY.		Insoluble Matter Si O ₂	Soluble Silica Si O ₂	lime Ca O	Magnesia Mg O	Potash K O ₂	Iron and Alumina Fe ₂ O ₃ Al ₂ O ₃	Phosphoric Acid P ₂ O ₅	Sulphur Trioxide SO ₃	Volatile Matter	Humus	Nitrogen N
1296	Miami	Soil	98.9080	0.0187	0.1740	0.0176	0.0185	0.1825	0.0182	0.0084	0.76	0.2720	0.0125
1297	"	Sub-soil	99.2900	0.0207	0.0960	0.0222	0.0174	0.3078	0.0087	0.0080	0.85	0.1850	0.0025
1298	"	Soil	97.5970	0.0192	0.1587	0.0222	0.0170	0.2100	0.0075	0.0012	1.985	0.6517	0.025
1299	"	Sub-soil	98.6610	0.0217	0.1960	0.0199	0.0145	0.2139	0.0050	0.0012	1.1550	0.8920	0.0145
1300	Lemon City	Soil	99.6060	0.0122	0.0812	0.0149	0.0170	0.0275	0.0062	0.0000	0.8340	0.1500	0.0080
1301	"	Sub-soil	99.8380	0.0102	0.0212	0.0099	0.1460	0.0162	0.0050	0.0000	0.1380	0.0460	0.0040
1302	Boca Raton	Soil	99.2840	0.0067	0.0187	0.0000	0.0097	0.0675	0.0087	0.0088	0.6500	0.2900	0.0120
1303	"	Sub-soil	99.7080	0.0067	0.0087	0.0000	0.0165	0.0887	0.0025	0.0088	0.2920	0.1550	0.0060
1304	"	Soil	99.6400	0.0052	0.0082	0.0000	0.0145	0.0850	0.0087	0.0047	0.2620	0.1900	0.0075
1305	"	Sub-soil	99.8600	0.0042	0.0087	0.0013	0.0145	0.0700	0.0087	0.0073	0.0980	0.1000	0.0015
1306	West Palm Beach	Soil	99.3170	0.0067	0.0087	0.0000	0.0140	0.1025	0.0087	0.0000	0.5280	0.2575	0.0150
1307	"	Sub-soil	99.7680	0.0062	0.0162	0.0013	0.0126	0.0625	0.0062	0.0000	0.1490	0.1325	0.0060
1308	"	Soil	99.3070	0.0147	0.0087	0.0000	0.0048	0.2210	0.0100	0.0088	0.4860	0.2000	0.0100
1309	"	Sub-soil	99.5840	0.0197	0.0000	0.0000	0.0126	0.2400	0.0087	0.0088	0.1620	0.0675	0.0045

CHEMICAL ANALYSES---Continued.

Number	LOCALITY		Insoluble Matter SiO ₂	Soluble Silica SiO ₂	Lime CaO	Magnesia MgO	Potash K ₂ O	Iron and Alumina Fe ₂ O ₃ Al ₂ O ₃	Phosphoric Acid P ₂ O ₅	Sulphur Trioxide SO ₃	Volatile Matter	Humus	Nitrogen N
1310	West Palm Beach	Soil	99.3800	0.0072	0.0062	0.0062	0.0097	0.0873	0.0067	0.0088	0.6260	0.1860	0.0120
1311	"	Sub-soil	99.6900	0.0067	0.0000	0.0000	0.0073	0.0935	0.0075	0.0000	0.2500	0.1075	0.0050
1312	"	Soil	97.0120	0.0092	0.0287	0.0158	0.0145	0.0800	0.0137	0.0047	2.8950	1.0080	0.0460
1313	"	Sub-soil	99.3630	0.0062	0.0012	0.0040	0.0067	0.0885	0.0075	0.0012	0.7240	0.2650	0.0115
1314	Jensen	Soil	99.1210	0.0232	0.0000	0.0085	0.0061	0.1617	0.0120	0.0000	0.7960	0.2825	0.0160
1315	"	Sub-soil	99.1380	0.0337	0.0012	0.0113	0.0122	0.3925	0.0135	0.0000	0.5000	0.1525	0.0070
1316	"	Soil	99.6230	0.0072	0.0112	0.0049	0.0073	0.0756	0.0056	0.0000	0.8760	0.1675	0.0090
1317	"	Sub-soil	99.8870	0.0067	0.0087	0.0049	0.0048	0.0725	0.0062	0.0000	0.0800	0.0500	0.0025
1318	"	Soil (Ex. Sta.)	99.3700	0.0132	0.0067	0.0058	0.0061	0.1700	0.0087	0.0000	0.4200	0.1600	0.0109
1319	"	Sub-soil	99.5670	0.0162	0.0000	0.0049	0.0048	0.1775	0.0062	0.0000	0.2480	0.1200	0.0055
1324	Jensen	Sub-soil	99.2660	0.0412	0.0062	0.0131	0.0110	0.3698	0.0194	0.0000	0.3160	0.1800	0.0050
1320	Eldred	Soil	97.3530	0.0482	0.0662	0.0511	0.0110	0.5106	0.0431	0.0107	1.5710	1.1800	0.0700
1321	"	Sub-soil	98.5620	0.0417	0.0312	0.0167	0.0122	0.4904	0.0306	0.0107	0.6480	0.8775	0.0240
1322	"	Soil	98.1400	0.0072	0.0187	0.0000	0.0134	0.1556	0.0106	0.0000	1.4680	0.5907	0.0380

CHEMICAL ANALYSES---Continued.

Number	LOCALITY.	Insoluble Matter Si O ₂	Soluble Silica Si O ₂	Lime Ca O	Magnesia Mg O	Potash K O ₂	Iron and Alumina Fe ₂ O ₃ Al ₂ O ₃	Phosphoric Acid P ₂ O ₅	Sulphur Trioxide. SO ₃	Volatile Matter	Humus	Nitrogen
1323	Eldred	99.5280	0.0117	0.0012	0.0053	0.0122	0.1587	0.0075	0.0000	0.2580	0.1250	0.0046
1380	St. Petersburg	99.2180	0.0067	0.0162	0.0053	0.0134	0.0406	0.0056	0.0008	0.7180	0.2775	0.0125
1383	"	99.6380	0.0102	0.0067	0.0131	0.0097	0.0220	0.0042	0.0000	0.8080	0.1675	0.0040
1382	"	97.5040	0.0232	0.0312	0.0357	0.0134	0.6981	0.0556	0.0084	1.7050	0.6870	0.0628
1388	"	98.0220	0.0242	0.0212	0.0366	0.0122	0.7294	0.0518	0.0000	1.0460	0.4985	0.0080
2384	Oneco	98.9880	0.0107	0.0187	0.0163	0.0122	0.0581	0.0106	0.0068	1.0950	0.2775	0.0245
1385	"	99.3560	0.0257	0.0012	0.0207	0.0122	0.1950	0.0862	0.0000	0.8620	0.1525	0.0050
1386	Punta Gorda	98.6160	0.0096	0.0850	0.0171	0.0170	0.0088	0.0187	0.0000	1.1386	0.4520	0.0280
1387	"	99.5820	0.0135	0.0475	0.0158	0.0122	0.0019	0.0081	0.0008	0.3800	0.1625	0.0080
1388	"	98.9000	0.0120	0.0475	0.0144	0.0110	0.0725	0.0050	0.0068	0.9882	0.4961	0.0250
1389	"	99.4696	0.0195	0.0800	0.0099	0.0061	0.0407	0.0068	0.0051	0.4480	0.2550	0.0080
1390	Orlando	95.6480	0.0880	0.0850	0.0482	0.0158	0.5698	0.0250	0.0051	3.9410	1.5560	0.0680
1391	"	96.7160	0.0480	0.0000	0.0896	0.0195	0.9016	0.0281	0.0017	2.2910	1.1480	0.0885
1411	Key			4.7259	1.5758	0.2963		0.9459		16.9861	24.5500	2.6463

MECHANICAL ANALYSES.

Station Number	Bureau Number	LOCALITY	Organ- ic Mat- ter Per Cent.	Gravel mm pr cent.	Coarse Sand mm pr cent.	Medi'm Sand mm pr cent.	Fine Sand mm pr cent.	Very Fine Sand mm pr cent.	Silt mm pr cent.	Clay mm pr cent.
1296	5527	Miami	0.62	Trace	9.56	22.60	68.72	1.72	0.56	0.50
1297	5528	"	0.82	0.00	9.53	25.10	61.86	1.72	0.66	0.20
1298	5529	"	1.58	1.20	9.28	23.92	60.76	1.52	0.62	0.24
1299	5530	"	0.66	0.00	8.46	24.82	62.88	2.20	0.86	0.28
1300	5531	Lemon City	0.22	3.72	21.72	28.42	44.68	0.76	0.04	0.00
1301	5532	"	0.18	3.96	20.96	29.34	43.78	0.80	0.10	0.14
1302	5533	Boca Raton	0.58	Trace	7.66	27.68	62.26	0.84	0.00	0.16
1303	5534	"	0.28	Trace	6.84	24.46	66.86	0.84	0.04	0.36
1304	5535	"	0.26	0.00	3.42	18.82	75.98	0.90	0.06	0.18
1305	5536	"	0.16	0.00	3.62	17.88	77.16	0.86	0.24	0.10
1306	5537	West Palm Beach	1.14	Trace	6.78	16.16	75.16	1.56	0.06	0.30
1307	5538	"	0.26	1.52	6.86	15.44	74.34	1.66	0.00	0.20
1308	5539	"	0.32	0.00	4.28	13.02	79.04	3.32	0.34	0.00
1309	5540	"	0.68	0.00	4.14	12.50	80.20	2.20	0.06	0.12

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PLATE VI.



Fig. 1. Native growth, Orlando.



Fig. 2. A Young Pinery at Orlando.

MECHANICAL ANALYSES---Continued.

Station Number	Bureau Number	LOCALITY	Organic Matter Per Cent.	Gravel		Coarse Sand		Medi'm Sand		Fine Sand		Very Fine Sand		Silt		Clay	
				2-1 mm pr cent.	mm	1-5 mm pr cent.	mm	.5-.25 mm pr cent.	mm	.25-.1 mm pr cent.	mm	.1-.06 mm pr cent.	mm	.06-.005 mm pr cent.	mm	.005-.0001 mm pr cent.	mm
1310	5541	West Palm Beach	0.30	1.26		26.00	44.40			26.64		0.34		0.00		0.34	
1311	5542	" "	0.28	0.80		20.90	44.12			29.32		4.26		0.10		0.34	
1312	5543	" "	0.30	0.10		25.42	44.36			27.64		0.64		0.18		0.14	
1313	5544	" "	1.88	1.04		27.92	44.34			23.20		0.36		0.30		0.04	
1314	5545	Eden	0.58	0.36		19.32	43.72			33.60		0.26		1.60		0.42	
1315	5546	" "	0.26	0.62		22.34	44.04			32.52		0.24		0.12		0.58	
1316	5547	" "	0.36	1.02		44.32	42.80			11.36		0.80		0.16		0.00	
1317	5548	" "	0.02	0.56		32.00	49.90			17.04		0.18		0.00		0.08	
1318	5549	Exp. Station	1.38	1.66		28.78	43.30			22.92		0.74		0.00		0.26	
1319	5550	" "	0.20	2.24		29.32	43.16			22.92		1.12		0.04		0.36	
1324	5551	Deep Sub*	0.88	1.64		30.84	41.84			23.70		0.92		0.18		0.44	
1320	5552	Eldred	1.80	0.34		18.68	49.64			27.38		0.70		0.28		0.26	
1321	5553	" "	1.10	0.48		16.02	52.78			27.90		0.64		0.22		0.44	
1322	5554	" "	1.16	0.28		18.60	50.24			28.20		0.84		0.06		0.18	

*15-26 in. deep.

MECHANICAL ANALYSES---Continued.

Station Number	Bureau Number	LOCALITY	Organ- ic Mat- ter Per Cent.	Gravel 2-1 mm pr cent.	Coarse Sand 1-5 mm pr cent.	Med'l'm Sand .5-25 mm pr cent.	Fine Sand .25-1 mm pr cent.	Very Fine Sand .1- .05 mm pr cent.	Silt .05-.005 mm pr cent.	Clay .005 mm pr cent.
1323	5555	Eldred	0.36	0.56	16.38	42.08	39.30	0.96	0.14	0.82
1380	6807	St. Petersburg	0.97	0.12	1.42	3.50	83.82	10.26	0.70	0.68
1381	6806	"	0.23	0.00	0.92	2.42	78.88	16.86	0.60	0.30
1382	6809	"	1.45	0.40	1.66	2.68	72.62	19.16	1.48	1.88
1383	6810	"	0.92	0.16	1.52	3.04	76.64	15.28	1.10	2.14
1384	6811	Oneco	0.88	0.32	2.34	5.86	76.76	13.32	0.86	0.56
1385	6812	"	0.35	0.30	3.70	6.84	79.30	8.14	0.54	1.14
1386	6813	Punta Gorda	1.18	0.08	1.70	4.66	78.00	13.74	1.02	0.82
1387	6814	"	0.42	0.14	2.26	6.22	76.44	13.84	0.30	0.28
1388	6815	"	1.16	0.14	2.84	6.72	73.50	15.00	0.56	1.12
1389	6816	"	0.58	Trace	2.00	6.02	75.02	15.84	0.32	0.30
1390	6817	Orlando	2.89	0.20	1.70	2.46	73.14	16.88	2.38	3.36
1391	6818	"	1.65	0.10	0.98	1.78	76.04	14.04	1.64	3.50

From the above figures it is evident that these soils are deficient in plant food when they are compared with Hilgard's averages of 466 soils taken from the humid regions of the United States.

HILGARD'S AVERAGE OF SOILS.

Potash.	Phosphoric Acid.	Magnesia.	Nitrogen.
0.1216 per cent.	0.108 per cent.	0.113 per cent.	0.225 per cent.

No. 1411 is an exception but this cannot properly be classed as a soil in the ordinary sense of the term. While all of them, with the exception of 1411, contain more than 95 per cent of insoluble matter, few of them have more than one per cent of material soluble in hot hydrochloric acid.

Few of the soils would be able to produce more than two or three crops of pineapples if all the plant food present were available. And when we consider that only a small proportion of this is actually in a condition to be taken up by the plants, we can readily understand why it is impracticable to produce pineapples on such soils without making liberal applications of a complete fertilizer. This explains in part why we have so many apparently worn out pineapple fields. It must be borne in mind, however, that the worn out condition of these fields is frequently the direct result of using improper fertilizers.

Although the quantity of plant food in our pineapple soils is small and no very great variations are apparent, yet personal observation indicates that the different types of soils here represented have quite a marked influence on the general condition of the crop. After a somewhat extended experience in making observations on the general conditions of the crops in the various localities, it has been decided that the soil from which sample No. 1320 was obtained fairly represents the best of our pineapple soils. Making due allowance for other factors, we

must conclude that the difference in the composition of these soils furnishes in a slight degree an index of the character and size of crops which may be expected. Referring to the notes on the native growth on the land just alluded to, it will be noticed that it was covered with a dense growth of hickory and other hardwood trees.

The land from which sample No. 1322 was taken is adjacent to that just mentioned and fairly represents the type of what is designated as spruce* pine land. By reference to the table giving the results of the mechanical analyses, it will be seen that there is practically no variation in the physical character of these two soils. Yet on the one hand the land is covered with a dense growth of hickory and other trees, while the other supports a heavy growth of scrub pine.

Even the chemical composition of the two soils does not vary widely but the hickory land is better supplied with nitrogen and phosphoric acid, while its potash content is somewhat lower.

Attention is called to the absence of magnesia in the scrub pine soil and though it would be unwise to draw any definite conclusion from this fact, it appears in most cases that the scrub pine land contains little or none of this compound.

It is difficult to compare the lands just mentioned with those used for pineapples on the west coast and at Orlando, inasmuch as there is a greater difference in the physical character than in the chemical composition. On the whole, the last mentioned soils contain a greater amount of plant food.

From the composition of the soils the grower should not start out with the expectation of having any of the fertilizing

*Commonly called scrub pine land

elements supplied from the soil itself, but should apply a sufficient amount of a proper fertilizer to meet all the demands of the crop as well as to make good the losses from other natural causes.

Soil No. 1411, as already stated, is not in reality a soil, but consists, for the most part, of a small amount of sand and disintegrated coral rock, with a large amount of leaf mould and other organic matter. At first sight, this soil seems to be exceedingly rich, and while its percentage composition indicates this to be the case, the total amount of plant food per acre cannot be very much greater than in some of the sandy soils on the mainland, because of the fact that the quantity of this material per acre can hardly be more than one-tenth the weight of soil on a like area. It is the custom to use no fertilizers on the Keys where this kind of soil is found and the land becomes exhausted after yielding three or four crops of pineapples. At the end of this time, the soil is completely worn out and little more than the bare rock remaining it is abandoned.

The physical characteristics of a soil are of primary importance, and determine largely the adaptability of a soil to certain crops. Moisture is the all-important factor in controlling plant life and upon its supply depends, to a great extent, the kind of vegetation best suited to a soil.

This moisture supply in a soil, when other conditions are the same, is largely determined by the texture of the soil. Soils are made up of masses derived from disintegrated rocks which vary in diameter, from less than one ten-thousandth of a millimeter to two millimeters. Before making the analysis, the coarser particles are removed by means of a sieve. Seven sizes of soil particles are recognized in making the analysis. It is

upon the relative proportions of these different sizes that the character of the soil depends. This, too, materially determines the capacity of the soil for holding moisture and influences the movement of water within the soil. Our ability to interpret the character of soils is as yet, by no means, what is desired, but within certain limits very definite information as to the adaptation of a soil to certain purposes is furnished.

In a general way all our pineapple soils are shown to belong to the same type, a type which is marked by the absence of any appreciable amount of very fine sand, silt and clay. The capacity of these soils for holding water is not great, inasmuch as the interstitial spaces are relatively large and are not altogether capillary, but are only such near the points of contact of the soil grains. In coarse, sandy soils, percolation and drainage take place rapidly on account of these large interstitial openings but in soils of fine texture, a preponderance of these spaces are capillary, hence, the water holding capacity of the soil is much increased and percolation is greatly diminished.

While the water-holding capacity of soils of this character is not nearly so great as those of finer texture, it will be seen that they may be divided into two classes, based upon the relative proportion of fine sand in them. The first group includes six soils from the East Coast, Nos. 1296, 1298, 1302; 1304, 1306, 1308, and those from other sections of the State. The soils of this group contain more than sixty per cent of fine sand. The second group embraces those East Coast soils containing less than forty-five per cent of fine sand. It is evident that the former have a greater capacity for water than the latter and this, other features being the same, determines the adaptability of a soil to a given crop. This is borne out by the

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PLATE VII.



Fig. 1. Native growth, Tauton's Key.



Fig. 2. Newly planted land at the left.
Pineapple field just before fruiting at right.

fact that with the exception of the Boca Raton soils, all those with a high percentage of fine sand are covered with a native growth of either Cuban or long leaf pine, generally with an undergrowth of saw palmetto, while the native growth on the soils of coarser texture is either hickory scrub or scrub pine. An inspection of the illustrations and a perusal of the notes on the native growth further illustrates the distinction. The native growth is an index of the character of the soil and serves as a valuable guide in the selection of pineapple lands.

The soils of coarse texture are better adapted to pineapple culture than those of fine texture in a climate like ours where there is a heavy precipitation of rain, for while the pineapple plant thrives where there is an abundance of rain, it will not grow in a soil that remains wet. In Florida the difficulty is obviated to a great extent where the soil is of a fine texture, by a proper system of ditching and bedding.

Requisites of a Good Pineapple Soil.

The first essential feature to be considered in the selection of a soil for pineapple culture is the temperature to which the locality is likely to be subjected. In Florida the bulk of the pineapples must be grown south of latitude 28 degrees, as north of this, and indeed for thirty or forty miles south of this line, killing frosts are likely to occur any winter. The fruit is grown many miles north of 28 degrees, but protection from cold by means of close sheds and artificial heat is necessary. This is so expensive that only fancy varieties can be profitably grown under such conditions. Latitude alone does not determine how low the thermometer may be expected to register, for we have what are termed cold streaks far south of local-

ities where frost rarely occurs. Proximity to large bodies of water materially influences the temperature of a locality. The water, on account of its great capacity for absorbing heat, becomes warm during the day and at night when the temperature of the air drops the heat absorbed by the water is slowly given off and in turn moderates the temperature of the surrounding atmosphere. Another factor which has a decided influence is that of elevation above the surrounding country. Such a point well elevated above a considerable area is heated by the warm air which rises from the lower level. It is a well known fact that warm air is lighter than cold air, and when frost occurs it is found decidedly heavier in low places. Cold air drops into these depressions and forces the warm air upward, so that the elevated points are not chilled so much as points on a lower plane. It will be understood that this applies only to moderate elevations, such as we may find in Southern Florida. It has been found that a system of clearing so as to facilitate a free circulation of the air has greatly lessened the liability of frost in sections on the East Coast. Many localities in that region which at one time were decidedly frosty, are rarely injured now by cold and this is attributed to the large amount of clearing that has been done in the neighborhood. When the land is elevated along the river front, it is advisable to clear out the undergrowth at least between the fields and the river so that free circulation of the air may be established.

In selecting a location, one must of course take into consideration the facilities which exist for shipping. Most of the land on the East Coast upon which pineapples can be successfully grown is near the railroad. The land lying out some distance from the road is, as a rule, too low and wet, or else is

PLATE VIII.



Fig. 1. Native growth, Myers.



Fig. 2. Pineapples at Myers.

PLATE IX.



Fig. 1. Pot-holes, laid bare, Miami



Fig. 2. Worn-out pineapple field, Jensen.

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subject to frost. In the other pineapple sections of the state this is not necessarily the case and the pineries are located near the railroads, not of necessity, but in order that proper facilities may be had for shipping.

What has been said concerning the selection of a location for growing pineapples has not applied to the soil itself, but its surroundings. There are certain essential features which the soil itself must possess in order for it to produce this fruit. In the first place, it may be said that the pineapple is an exhaustive plant and requires large supplies of the three most common fertilizing elements. Unfortunately, we have little choice in the selection of soils from this standpoint, since none of our soils will, without fertilizing, produce pines for any length of time except on the Keys, and even here the fourth crop usually ends the life of the field.

Much carbonate of lime in a soil renders it unfit for pineapple culture and attempts to grow the fruit on our shell lands have not met with success. An acid soil is also to be avoided, since it is almost invariably the case that plants growing on such soil have a decided tendency to spike. It is true that pineapples will grow on widely differing types of soil so far as composition is concerned, but in all these cases, the physical character of the soil is approximately the same. It seems absolutely essential that the soil must be of such a nature as to afford good drainage and complete absence of stagnant water around the roots. The root system of the plant is not extensive and its entire structure is such as to adapt it to dry districts and it cannot possibly thrive in Florida where we have such a heavy precipitation of rain, unless the water rapidly drains away.

Acknowledgements.

The writers in closing desire to acknowledge their indebtedness and appreciation of the kindness of the officials of the Georgia, Southern and Florida, the Atlantic Coast Line and the Florida East Coast for transportation furnished in carrying out our investigations. We are also greatly indebted to Mr. A. W. Blair, of the Department of Chemistry in the University for the very careful manner in which he executed the analytical work in connection with this publication.

FLORIDA
AGRICULTURAL EXPERIMENT STATION

Cultivation of Citrus Groves,



CULTIVATING CITRUS TREES WITH AN AOME CULTIVATOR

"There is more difference of opinion regarding cultivation than perhaps any other one point in orange growing."—Manville.

By H. HAROLD HUME.

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Cultivation of Citrus Groves.

Introduction.

The object of growing and cultivating the various kinds of citrus trees is the production of fruit of good quality and plenty of it, but while it is true that this is the desired end, it is equally true that the means by which this desideratum may be secured, are not the same in all cases.

As a matter of fact, there is probably no practice connected with the growing of citrus fruits regarding which there is more difference of opinion than there is upon the question of the best methods of grove cultivation. The soils of our State are so extremely varied, both in the amount of fertility and in the amount of moisture which they contain, that it is not to be wondered at, that such is the case. To anyone who understands the nature and character of our soils, it must be patent that in a large measure, the system of cultivation adopted must correspond to the kind of soil. But after all, it will generally be found that underlying each system there is some one, broad, general principle.

Soils.

While it is not the object of this section to discuss the kinds and relative merits of the soils upon which citrus fruits may be grown, still it is necessary, for the better understanding of the subject, to define and briefly describe those generally in use.

The soils of our State are commonly grouped according to elevation and the growth which they support or have supported

in a virgin state. Those usually used for citrus culture fall naturally into four groups, namely: high pine land, flat woods, high hammock and low hammock. High pine land is well elevated, usually well drained and supports a growth of long-leaf pine (*Pinus australis* Michx.) with little or no undergrowth, though sometimes a few high ground willow oaks (*Quercus cinerea* Michx.) and other hard wood trees are found. Flat woods land likewise supports a growth of long-leaf pine, but the elevation is considerably less and the ground is quite flat and level. In the southern parts of the State, in the vicinity of Miami and Punta Gorda, for instance, and generally south of a line from Cape Canaveral to Tampa Bay, the long-leaf pine is replaced by the Cuban pine (*Pinus Cubensis* Griseb.) Frequently the flat woods land is thickly covered with an undergrowth of saw palmetto (*Serenoa serrulata* Hook.) and gallberry (*Ilex glabra*.) During the rainy season, most of these soils are quite moist. They are generally underlaid with a subsoil of clay, hard-pan or rock. The high hammock lands are covered with a hard wood growth of evergreen and deciduous trees. Among these may be mentioned holly (*Ilex opaca* Ait.), hickory (*Carya tomentosa* Nutt. & *Carya glabra* Torr.), willow-leaved oak (*Quercus Phellos* L.), live oak (*Quercus virens* Ait.), magnolia and cabbage palmetto (*Sabal palmetto* R. & S.). The low hammock land lies at a lower level than the high hammock, but supports in a native state, practically the same growth. To the trees already mentioned, however, may be added sweet gum (*Liquidamber styraciflua* L.) and black gum (*Nyssa sylvatica* Marsh.). Some of the low hammock lands are covered entirely with a pure growth of cabbage palmetto and live oak.

The hammock lands generally contain larger amounts of humus and are materially richer than high pine lands. In addition to these soils, mention may be made of the hickory, or hickory scrub lands stretching in broken areas along the shores of the Indian River from about Cape Canaveral northward. They are covered for the most part with a species of hickory (*Hickoria carliaonæ-septentrionalis* Ashe) and the soil is a pure yellow sand, the surface soil having a fair admixture of humus. In some respects, these lands correspond with the high pine lands of the interior and appear to be well adapted to the cultivation of citrus fruits.

Clean Culture or No Culture?

The practice of keeping the ground on which the orange grove stands perfectly free from herbage and thoroughly cultivated throughout the whole season, year in and year out, has been indulged in by many and is still followed by some. This method has little to recommend it. A soil so treated soon becomes depleted of its natural fertility and the humus soon becomes used up through constant cultivation and the application of various fertilizers. No amount of fertilizer will do the work it should, if the soil once loses its natural body and becomes deficient in humus. In spite of every effort in the line of fertilizing, such a soil will become poor and infertile; the trees will soon show the effects in their unhealthy condition, and the owner will realize it in his diminishing returns.

If clean culture is adopted, humus must be supplied in some way, and the plan used by a number of successful growers in the State is to cover the ground with a liberal coating of leaves and leaf mold from an adjoining hammock. By this means a

mulch and the material from which humus may be formed are provided for the soil. It is far easier to maintain the humus content of soils than it is to replace it, after it has been once worked out of them, a fact which it is well to bear in mind.

Humus, one of the most, if not the most important ingredient in any fertile soil, is generally found in inadequate amounts in citrus soils, and any system of cultivation which does not tend to increase the amount or maintain a considerable quantity of this substance in the soil is not based upon scientific principles.

Any piece of ground denuded of its natural covering of vegetation, and so exposed continually to the burning heat of our sub-tropical sun, rapidly loses most of its fertility and becomes dead, lifeless and useless. The soil must not be regarded only as a place for roots to grow and live in, it must be looked upon as nature's food-producing laboratory, in which multitudes of micro-organisms or bacteria are busily engaged in preparing food for the plants which grow on it. They fail utterly in the performance of their work if their natural element, a soil rich in humus, is by some means converted into a sandbank. This is exactly the result of long-continued clean cultivation.

On the other hand, many growers do not cultivate the soil at all, and on some classes of soil this method is really the best. Only on naturally moist soils, low, damp hammocks, for instance, should this plan be adopted. On the high pine lands, or on those naturally deficient in moisture, it is not a safe method to follow. Cultivation conserves soil moisture, and increases the water-holding capacity of the soil. Perhaps never before, in the history of citrus culture in Florida was the necessity for frequent cultivation so forcibly borne in upon the minds of all thinking growers as it was in the spring of the year 1902, and yet if all the moisture, or

even a considerable portion of that which the soil contained at the beginning of the season, could have been held and dealt out gradually to the trees, there would have been sufficient for their needs. Frequent, shallow cultivation would have helped materially in this direction.

In June, 1902, two samples of soil were taken as representative of cultivated and uncultivated soil. Both were from the horticultural grounds, one from soil planted in citrus trees, cultivated frequently from March until that time, the other from a piece of ground which had received no cultivation at all during the season, but which had lain bare and exposed to the sun. The samples were weighed, then dried and weighed again. The weights and differences were as follows:

Cultivated soil—weight when collected, 247.8 grams; weight after drying, 230.5 grams; loss of moisture in drying, 17.3 grams; per cent moisture in sample, 17.3, divided by 247.8, multiplied by 100, equals 6.97 per cent.

Uncultivated soil—weight when collected, 251.4 grams; weight after drying, 240.9 grams; loss in drying, 10.5 grams; per cent moisture in sample equals 10.5 divided 251.4, multiplied by 100, equals 4.17 per cent.

The cultivated soil contained 6.97 per cent moisture, while the uncultivated soil contained 4.17 per cent moisture, a difference in favor of the former of 2.8 per cent, or, expressed otherwise, cultivation had increased the moisture content of the soil by 66.5 per cent. It is true that the water holding capacity of most Florida soils, and particularly of those rich in humus, is well up to the average, but this does not mean that every effort should not be made to hold and conserve the moisture for use during the spring drouth. Lands deficient in moisture should be cultivated fre-

quently during the first half of the year, or rather from the commencement of the growing season until the rainy season begins.

Benefits of Cultivation.

Because of their loose, open nature, it is not so difficult to keep our fruit lands in good condition, as it is in some parts of the country. Neither the same amount of time, nor the same amount of labor is necessary to keep our citrus groves in good tilth as is required by fruit plantations in most of the fruit-growing districts of America. Perhaps herein lies the reason why some have neglected cultivation altogether on lands which would be benefited by it, while others have, in many cases, carried the practice too far. But if our soils are in apparently good condition and roots can easily penetrate them in all directions, then in what way does cultivation benefit the trees, and why is the operation necessary?

Cultivation is beneficial in the following ways: It increases the water-holding capacity of the soil and conserves moisture, both by allowing rain to sink more freely into it and by checking evaporation. It pulverizes the soil and allows the air to penetrate, thus supplying oxygen to the roots. In cultivated soils, decomposition and nitrification go on more readily and if the materials are present from which nitrogen can be formed, its formation takes place more rapidly than if the soil be left uncultivated.

Most of the moisture in tillable soil is held as a minute film surrounding the soil particles. It necessarily follows that the more numerous the soil particles in a given space, i. e., the smaller they are, the greater will be the water-holding capacity of the soil, because the total surface area of all the particles increases as they are reduced in size. And it is true, within certain limits, that the

water-holding capacity of a soil increases as the size of the particles diminishes. If, however, the particles become too small, they may become too closely packed, and thus this object of cultivation will be defeated. This condition is not likely to occur in Florida soils as a result of cultivation. The size of the particles can be reduced by cultivation by breaking up masses which may have become more or less cemented together, and the water-holding capacity thereby increased.

The opening and loosening of the soil permits the rain to penetrate. If the surface of the ground becomes hard and compact, the water will run over the surface or collect in puddles and disappear by evaporation. In either case the loss will be great. But if the soil is well stirred and loose, the water will enter.

Once it is safely beneath the surface, it is necessary to keep it there; it has gained entrance by a passage through which it should not be allowed to escape. The water will again make its way to the surface by capillary attraction, passing upward through the minute spaces between the particles of soil. If these minute tubes or passages, extend right to the surface, the water rises to the top, comes out, and is carried away by evaporation. Frequent, shallow cultivation will prevent this escape of water, by breaking the capillary tubes. The top inch or two of earth is stirred, it parts with its moisture and becomes quite dry. Then it acts as a dust blanket and the great amount of moisture below is not allowed to reach the surface to be carried away by the moving air above. Thus the moisture is conserved and held for the use of the trees. During our rainy season it is not necessary to conserve the moisture, but often in April, May and June, and sometimes even later, week after week goes by without a shower. This is the time when water is needed, the time for which preparation should be made

before it comes. *The horse and cultivator are often a most excellent substitute for an irrigation plant.*

We know that a hard, compact soil into which air does not enter, is no fit place for the roots of plants to grow and live in. The roots absorb water and food in solution, only through their newer parts, and new roots must be formed constantly to carry on this work. For the formation of roots, oxygen is necessary, and if the air cannot enter, oxygen cannot be supplied, and the roots suffer in consequence. The soil should be kept loose and friable during the period of greatest growth that the roots may be freely supplied with air.

If, in addition to this, the rootlets can reach and penetrate every portion of the soil, growing here and there at will, they then have every opportunity to come in contact with and absorb the plant food in the soil. While it is true that food materials in solution, may move towards the roots, still in general, the roots must search out and procure the plant food. How can they do this important work if the soil is hard, compact and impenetrable?

The food materials in any soil are found either in chemical substances, present in the soil, or in organic combinations. If fertilizers are applied or added to the soil, they too fall into, either one or the other of these classes. Most of these materials do not immediately yield up the plant food which they contain, but they must be acted upon by certain agents before their store of food becomes available, i. e., so that the roots can absorb and the plants use it. A large part, or practically all, of the plant food in organic substances is liberated through the agency of microscopic plants called bacteria. That these may thrive and multiply, plenty of air should be admitted to the soil, and the soil should at the same time be warm and moist. Cultivation goes a long way to-

ward making the conditions ideal for the growth and development of soil bacteria. The other class of agents is those which act chemically. To this group belong the acids and other substances which are capable of breaking up the food-containing materials in the soil. Some of these disintegrators are present in the air, and are carried to the soil in the rain. Here again, cultivation helps by admitting the air to the soil and allowing the rain to penetrate.

Humus and its Value.

Humus is a product of the decay of organic substances. When these undergo decomposition in the soil, humus is the intermediate product formed, that is, just before the resolution of the organic material into its component chemical parts. It is probably not too much to say that humus is the most important substance found in any fertile soil, and its presence may generally be taken as the index of fertility. The truth of this statement may be realized more fully, when we remember the fact that all barren soils are lacking in this substance and the chief difference between a barren and a fertile soil is usually a difference in humus content, not in the mineral ingredients.

The changes which are constantly taking place in soil may be grouped as physical, chemical and biological. The first relates to the movement of water, the size of the particles and the mechanical changes such as those produced by the displacement of the soil particles by animals or the roots of plants. The second includes all changes wrought by the action of acids or other disintegrators of a chemical nature, while the third in its use here refers to the changes brought about by soil bacteria. All three of these changes whether chemical, physical or biological, are intimately associated with the presence of humus.

In regard to the first it may be premised that soils rich in humus are not solid and compact, but loose, open and better aerated than those lacking humus and that the water-holding capacity is materially increased by a fair admixture of humus. Now, if the ability of a soil to retain moisture is increased by the presence of humus, it follows that all plant food in solution will be held as well, and this is an important feature.

Humus contains from three to twelve per cent of nitrogen and this in itself is a fact worth bearing in mind, but it has been ascertained besides that soils rich in humus are usually well supplied with phosphoric acid and potash.

Reference has already been made to the bacteria which play an important part in the formation of plant food and which are so intimately associated with the work of providing nitrogen for the use of the trees. It may be said that but little nitrogen from those materials in which it is usually found in or supplied to the soil would be available for the trees were it not for their presence, and the bacterial content of the soil, other conditions having been met, is dependent entirely upon the presence of humus.

Hence, it will be seen that humus is a very valuable soil component, and is intimately associated with the life activities of a fertile soil. Growers of citrus fruits in Florida use commercial fertilizers in large quantities. Many of the substances applied must undergo certain changes before they can become available. This change from an unavailable to an available state is dependent either upon the action of soil bacteria or chemical agents. Humus forms the media in which the bacteria work and furthermore it holds the plant food when in solution until the roots have a chance to use it. *The best and fullest effects cannot be secured from applications of fertilizers to citrus trees unless the soil be plentifully supplied with humus.*

Depth of Cultivation.

It is always preferable to prepare the ground well before the trees are planted. The earth should be well stirred and free from roots and stumps. During the first years of the life of the young grove the ground may be plowed, if deemed advisable, provided always that the plow is not run deep, close up to the trees. The tree rows should be cultivated comparatively shallow. This treatment will have a tendency to send the roots deeper into the soil as they spread out from the trees. If plowing is resorted to, the depth should be varied from year to year, so that the soil may not become hard and compact, at a certain fixed depth, as is likely to be the case if the plow is always run at the same distance from the surface.

When the trees have attained considerable size and the roots have occupied the whole space between the tree rows the plowing should be very shallow or should be abandoned entirely, the plow giving place to the cultivator. The method followed in the old groves around Lake Orange was to give three or four hoeings during the year, all the cultivation the trees received and the results were highly satisfactory. The plow as an implement for continuous cultivation should not be used. If used at all, plowing should be done only during the dormant period, early in the spring or late in the autumn. Its use after this time should not be resorted to. Large numbers of roots are broken or torn by the plow as a result of which new ones are formed rapidly, food is absorbed in great quantities and a die-back condition only too frequently results.

In most cases the fibrous feeding roots in old groves form a solid mass and these extend quite close to the surface. In such

cases cultivation should be shallow, but if a proper system of cultivation has been carried on from the first, the roots will not be too close the surface. This mat of roots is usually disturbed to some extent, but considering the fact that commercial fertilizers are used extensively, it is not good policy to cultivate deeply and break them up too much. Shallow cultivation should be the rule, a rule to which there may, of course, be some exceptions.

Spring Cultivation.

As soon as the danger of frosts is past, the banks should be removed from the trees. The wood left over from the winter's protection work should either be piled in the tree squares or removed entirely from the grove and placed against the fence. The former practice is preferable as it reduces the amount of labor required in keeping the wood on hand. No detrimental effects come from allowing the wood to remain in the grove as the soil beneath the piles is kept moist and in good condition.

If the grove was cultivated in the fall and put in good shape, but little requires to be done in commencing operations in the spring. If the soil is inclined to become packed, it would probably be preferable to give the first cultivation with a cut-away harrow, following this up with an Acme or Planet Jr. cultivator. On lighter soils or on those which are in good tilth, the cutaway harrow may be omitted. During the Spring, the grove should be cultivated frequently. The driest weather of the year in Florida comes during the months of March, April and May, and during this time the soil should be cultivated at intervals of not more than ten days. If showers fall, it is by all means advisable to cultivate after each one, as soon as the ground can be worked.

Summer Cultivation.

At the beginning of the rainy season in most parts of Florida it is advisable that cultivation be discontinued, and in no case should it be prolonged much past the first or the middle of August. If beggarweed has been planted as a cover crop and cultivation has been discontinued after the middle of July, it will add greatly to the convenience of fall cultivation to have the beggarweed cut once or twice during the summer. If allowed to grow without interruption throughout the whole season the crop becomes so large and strong that it is very difficult to incorporate it with the soil in autumn. Two cuttings can be made, one about the middle of July and the other about the first of September, after which time the plants will sprout and in most cases sufficient seed will be matured to re-seed the ground. The cuttings can be removed for hay if so desired, but if the soil is rather poor or lacking in humus, this should not be done, but the crop should be allowed to remain and dry on the surface.

Winter Cultivation.

Before the frost period the grove should be cleaned up. It has been observed that the presence of grass or weeds in the grove increases the danger from frost injury very materially and for this reason the cover crop should be incorporated with the surface soil not later than the middle of November in the Northern districts, while in the Southern, where damage from frosts does not occur, it may be allowed to remain on the surface of the ground until later. If a heavy cover crop has been grown, it is rather difficult to turn it under. A corn-stalk smasher frequently proves very useful in breaking up the dry stems. If this is followed by

a cutaway harrow, or in some cases a very shallow plowing may be given, it will put the grove in condition for the winter months. During the winter no cultivation should be given but the grove should be allowed to remain untouched until the opening of spring.

Cultivation in Relation to Die-Back.

When citrus trees become affected with die-back, it is usually advisable to discontinue cultivation until such time as the trees are brought out of the condition. Cultivation seems to favor the development of the disease, a disorder which is almost certainly due to the presence of an enzyme in the soil. The fertilizers applied should be pure chemicals and no organic source of nitrogen should be used. Hygienic treatment along these lines will usually bring about a change in the condition of the trees. For further discussion of the disease, see pages 160 and 161 of Bulletin 53, Florida Experiment Station.

Cultivation of Wet Soils.

The treatment of the moist soils of the State must be radically different from that given the dry soils. Even in the spring months, many soils in which citrus trees grow in the State are so charged with moisture that it is by all means advisable to get rid of some of it. The practice followed by some of the most successful growers on those soils is to allow the native plants and herbage to grow up and develop throughout the whole season. These pump the moisture from the soil and assist materially in getting rid of the surplus. From time to time during the spring and summer months, the cover of native herbage should be cut down and allowed to die and decay on the surface.

Implements,

One of the best implements for shallow cultivation is the Acme harrow. It is excellent for breaking up small lumps and keeps the surface of the ground in good tilth, at the same time providing a dust blanket on the surface. The new Acme cultivator, with a long rod at the center which allows the two sections to be pushed apart, makes it one of the best implements for grove cultivation. The earth can be cultivated right up to the tree trunks without the horses interfering with the branches of the trees.

The Planet Jr. implements are very good for grove cultivation. Among these, the No. 41 Orchard and Universal Cultivator is a very serviceable implement.

Many different kinds of cultivators are manufactured and in use. Of the small ones mention may be made of one manufactured by Mr. T. K. Godbey, of Waldo, Fla.

For early spring cultivation, the cutaway harrow frequently proves very useful, but it should never be used without being followed up with a cultivator or harrow. For shallow cultivation and preserving a dust mulch, some of the weeders should be provided. These are large and light and permit of very rapid work. For disposing of a heavy cover crop, a corn stalk smasher frequently proves very useful.

To the implements referred to above, a good plow or two should be added. These implements are about all that are necessary for the cultivation of a citrus grove in the State of Florida.

Methods of Successful Growers.

The following list of questions was submitted to a number of successful growers operating on different classes of soils in var-

ious parts of the State, in order to obtain definite information concerning their methods:

First. Kind of soil and subsoil, distance above water level, high or low hammock, high pine land or flat woods? Well drained, wet or dry? Second. When do you commence cultivation in the spring? Third. Do you cultivate during the blooming period? Fourth. When do you cease cultivation? Fifth. What implements do you use? Sixth. How often do you cultivate? Seventh. Is a cover crop grown? If so, what plant? If you do not allow a cover crop to grow, how do you supply humus? Eighth. What fall and winter treatment do you give? Ninth. How often do you fertilize and at what time?

The answers to these questions are given below over the signatures of the growers. The methods may be taken as being among the most progressive and up-to-date now followed in the State. It is well to note that all these growers adopt some plan to maintain the humus content of the soil, most of them by growing a cover crop.

1. Sandy loam on clay subsoil, about eighteen inches to clay. Distance to ordinary water level, about sixteen feet. Pine land about half way between high pine and flat woods. Fairly well drained naturally, but supplemented by a system of open ditches.
2. About April 1st to 15th. Should often commence earlier than we do except for being rushed with nursery work.
3. Yes, if we can get at it in time.
4. When rainy season has fairly set in, in midsummer July 1st to August 1st.
5. Clark Cutaway Harrow for first one or two cultivations; then the Acme Orchard Harrow.
6. About every ten days or if extremely dry, once a week.
7. Yes, beggar weed. We believe beggar weed to be the best humus producing plant for Florida orchards.
8. Beggar weed

is either mowed late in the fall, or cut up with a cotton stalk cutter; then plowed under. Trees are banked about eighteen inches high with earth. 9. We fertilize at time of cultivation, about April 1st, and again about July 1st, just before ceasing cultivation.—G. L. Tabor, Glen St. Mary, Fla.

1. Top soil fairly rich, sand and humus for five inches or a little more, yellow sand below. Distance above water level, eleven feet. Gray hammock and high pine land, naturally well drained. 2. As soon as wood can be removed safely and the banks taken down. 3. Would if it were not for wood and holes made by banking trees. 4. When summer rains commence, about June 1st, also fertilize at last working. 5. Half shovel plow first year or two and after that the cutaway, Alliance and Spring tooth harrows. 6. As often as I can through the drouths of late March, April and early May. Sometimes oats and rye in early winter, beggarweed and grass in summer and fall. Haul in leaves whenever opportunity offers. 8. Bank trees; fertilize in November and work it in lightly with Clark's Cutaway harrow. 9. Answered above.—W. S. Hart, Hawk's Park, Fla.

1. Scrub hammock, verging on gray hammock. Fifty-six feet above water level. Dry, very much so. 2. After bloom is set. 3. No. Cultivate from March every two weeks until July or rainy season—then once a month until October. 5. Scratch harrow and flat sweeps. 6. Answered under No. 4. 7. No. Supply humus from hammock rakings. 8. From October till March none, except scratch harrow the middle of January when I fertilize. 9. Twice a year, middle of January and end of June.

1. Our grove is situated on low cabbage palmetto hammock land, from two to ten feet above high tide, underlaid with a

clay subsoil in spots and in other parts with a thin flat rock, about eighteen inches from the surface. Part of the land is underdrained, the remainder is well drained with open ditches. Young portion has been raised on ridges; these ridges are made according to the dip of the land which affords surface drainage between them.

If I could do as I wished we would fertilize and cultivate the groves the last of October, and not later than the 15th of November, hoeing all trash from around the trees. Then let the trees remain dormant as long as they would, not stirring the soil until the bloom had come and fruit set the size of a buckshot. Commence work with a disc harrow, on wheels, (which allows any depth desired). I should alternate this with the acme harrow until the rain season sets in (usually the 15th of June), when all cultivation should cease until October. If grass or weeds grow luxuriantly I would mow them about two feet high, the first I let remain as it is cut by the machine. This soon disappears in the stubble the next time I use the cutting for mulching the trees. The material rots and gives humus, as does the stubble plowed under in October. On account of our vegetables, we do our work when we can spare the time from the vegetable crop. I would prefer to fertilize three times, in March, June and October. The groves are seeded to crabgrass, weeds and beggarweed. One forty-acre block is almost solid Bermuda grass. This we do not plow, as it is impossible to work it shallow. These trees are hoed and mulched as much as possible and they are doing fairly well. —F. D. Waite, Palmetto, Fla.

1. High and low hammock. High scrub, hickory, with pine trees.
2. February 15th to March 15th, owing to season. Cultivation very slight.
3. No, not at the beginning, but sometimes

bloom is still on when we cultivate. 4. When rainy season comes on. 5. Mowing machine, disc harrow; hoe around the trees. 6. Weather conditions determine, but as little as possible. 7. No, don't believe in cover crops. Use mulching around trees as source of humus. 8. Mow closely, and mulch trees, no cultivation. 9. Twice a year, three times in some seasons. November, February or March and in June, July or even August, owing to weather conditions.

On high hammock and scrub pine land some cultivation with disc harrow is all right, but on low hammock almost no cultivation should be the rule, say one, or not more than two chop hoeings in the year and trees mulched. The minimum of cultivation in the orange grove to keep the trees healthy and growing enough to make some new wood at right seasons, but no more is the ideal method. We must look at our trees, and remembering the fertilizers applied, determine as to the amount of cultivation.—E. P. Porcher, Cocoa, Fla.

1. I have grown my grove upon high pine land, which from my observations has proved the most successful for cultivation of citrus fruits in South Florida. 2. Commence cultivating in spring as soon as danger of frost ceases. 3. I have cultivated during the blooming period and have never seen any ill effect. 4. Stop cultivating at the beginning of the rainy season. 5. I use Planet Junior orchard wheel cultivator for breaking up and Acme harrow for smoothing down and keeping the surface stirred. 6. I plow my groves in fall turning toward the trees, and again about the beginning of the rainy season, throwing into beds between the rows. During the spring months, I keep the surface well worked and endeavor to stir the land after each rain. I have my trees hoed around once or twice during the year. 7. I grow

beggarweed and crabgrass in my grove during the summer season. 8. After plowing in November and December, I do nothing to my grove until the approach of spring. 9. Three to four times during the year. First in the fall just previous to plowing, second, in April after the spring growth begins to harden or begin in July after the second growth has matured. Never fertilize during the period of the unfurling of growth.—F. W. Inman, Winter Haven, Fla.

1. Pine and willow oak with chocolate colored sand for subsoil. Six to twelve feet to water. Well drained. 2. In past years have waited until the spring leaves were about grown. Have been trying nonculture for two years, but now consider the conservation of our winter rains the greatest essential and shall begin cultivation as early as danger of frost is fairly past. 3. Shall this year. 4. June or July according to size of fruit and color of leaf. 5. Plow, spading, cutaway and acme harrows. Planet Junior orchard cultivator, sweep and Junior Acme, shall use the weeder every ten days during spring drouth and especially as soon after each rain as the top of the ground begins to dry. 7. Have had beggarweed in my grove for twelve years, and while it has improved the soil and saved nitrogen bills, upon the other hand, the rapid nitrification going on among its roots during the summer months has produced die-back, resulting in pinching in the orange trees to such an extent as to outweigh all benefit derived from it. I now mow twice each year and carry the beggarweed off for hay. The trees are improving in health. Except by mowing, the amount of nitrogen furnished the trees by beggarweed cannot always be governed and worst of all the nitrogen is largely furnished during July, August and September, when most objectionable. 8. Plow when cold weather sets in and then try to

keep the trees as dormant as possible, but would appreciate a tree hypnotist, who could put them soundly to sleep until spring.

9. First about the last of January, using a high percentage of nitrogen, second, during May, using a small percentage of nitrogen and third, in September or October, using little or no nitrogen.—C. W. Butler, St. Petersburg, Fla.

1. High, rolling, pine land, about 30 feet to water (dry). 2. About March. 3. No. 4. September or October. 5. Hoe for shedded trees, plow outside. 6. Three times. 7. Yes, outside. We grow none under the shed. Velvet bean. 8. Bank outside trees. 9. Twice, in spring and October. Give trees in shed three pounds, twice a year.—H. B. Stephens, DeLand, Fla.

The spring of 1900 found my groves killed to the banks. The fall of 1902 I sold 800 boxes of oranges and grapefruit from about 300 trees, 10 to 12 feet high, spread about 10 feet; from 150 smaller trees, 65 boxes. One grove of 300 trees more exposed lost most of its bloom by late frost.

Since our first big freeze when all the trees went, I handle my groves in a different way from what I had up until that time. The velvet bean was introduced and with that the change. Until then my groves were worked and fertilized according to established rules.

Last week in January, or thereabout, before the bloom and growth starts, the plow is run, very shallow, straight along, six feet away from the tree rows. The strip between the tree rows is left, never being disturbed, neither by plow nor hoe. Nothing further is done until about March 1. when all the rest of the land and the old stubble of last year is planted as thick as possible with velvet beans. The vines receive one working with a plow, no hoeing. They grow, covering everything with a dense mass of

vines and layer of rotten leaves. An Acme cultivator is run along the six feet of plowed ground as long as the vines will permit. Nothing more is done, except to keep the vines from the trees, and the trees are never plowed. When the cold kills the vines, they are drawn into piles with the horserake, and later they are placed around the trees and on the strip between. No beans are picked, except enough for seed. The trees are banked by December 1. No other fertilizer than the velvet bean has been used now for six years or more. Date of writing all trees look luxuriant, covered with new growth, and extra heavy bloom. Last fruit was perfect, pronounced by Mr. Arnold, of Jacksonville, who bought it all on the trees, as being the best he had ever handled. I will not claim that I shall never have to use any other fertilizer, but thus far, there is no indication of the need of it. Expenses per year are about \$25.00, except cost of banking and removing the same. Peach trees are planted between most of the orange trees. They receive the same treatment, cost no extra work, and produced about three pecks to the tree the third year after planting. Orange trees are sprayed once a month for rust mite.—H. von Luttichau, Earleton, Fla. Dated Feb. 16, 1903.

Citrus Growers' Calendar.

It is not possible to place each of the distinct sets of operations connected with the growing of citrus fruits in a separate and definite place in a calendar, but the following may serve as a sort of guide.

Propagation Work.—November-December. Cut budwood for spring work.

March—Insert first buds, unwrap and examine ten days later

and rebud those which have not united. Three or four days later lop off those which have united. Stake and top when from fifteen to eighteen inches high.

Cultivation—January or February—Overhaul all cultivating implements, make such repairs as are needed and see that everything is in working order.

March—In exposed sections remove banks about the middle of this month and either remove wood from groves or pile it neatly so as to permit cultivation.

March, April, May and June—Cultivate groves (except those on moist soil) once every week or ten days if the weather be dry. If showers are scattered through this period, cultivate immediately after each one.

November—Cultivate lightly once so as to break down grass and weeds. In exposed situations provide necessary wood for firing and bank trees.

Spraying for Fungi.—For scab on Satsuma or lemons, spray just after the blossoms fall and the fruit is about a quarter of an inch in diameter. Give two other applications at intervals of two or three weeks. Use Bordeaux mixture or ammoniacal solution of copper carbonate.

Spraying for Insects, by H. A. Gossard.

February and March—Spray with potash whale-oil soap for young scale, red spider, rust mite, and thrips just before bloom opens. If white fly is present, this will be the third spraying for the winter brood.

April—Dust with sulphur and lime, using Jumbo Duster.

May—Spray with whale-oil soap-sulphur solution as soon as white fly larvæ are well hatched, killing scales, red spider and rust mite at the same time. Spray whether white fly is present or not.

June—Dust with sulphur and lime.

July—If white fly is present, spray with whale-oil soap. If only scales and rust mite are present, Hammond's Thrip Juice, mixed with sulphur solution, can be used at the rate of one part of Thrip Juice to one thousand parts of soda-sulphur solution.

August—Dust with sulphur and lime.

September—Dust with sulphur and lime.

October—Dust with sulphur and lime.

November or December—Spray with resin wash or whale-oil soap for white fly and scale. Never spray same tree more than twice with resin wash in one year.

December—Late in this month spray a second time for white fly, using resin wash or whale oil soap.

Handling Crop—August and September—Take inventory and order necessary box materials, hoops, wrappers, stencils and other supplies.

September—Overhaul packing house and see that everything is ready for work. Repair and provide field boxes and all necessary utensils. When season is closed, place everything in order for the summer months. If ripe rot fungus has been prevalent during the season, fumigate the packing house.

Fertilizing.—Order all fertilizers in good season.

February—Make first application of fertilizer. In northern citrus belt, apply in March.

June, July—Give second application, if only two are given.

September—If three applications are made, give the third one the latter part of this month.

H. HAROLD HUME.

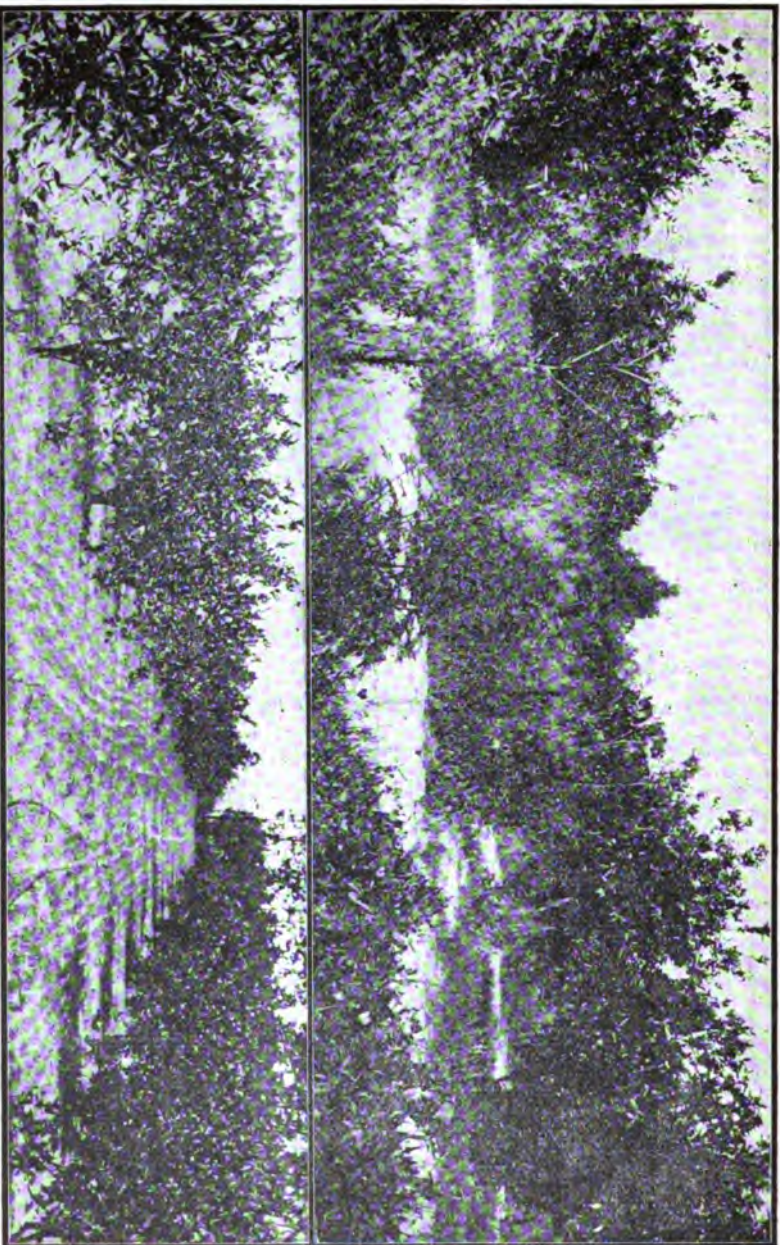
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27 Pineapple	" 14	53 Some Citrus Troubles.....	" 35
28 Liver Fluke — Southern Cattle		54 Pecan Culture	" 31
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		68 Pineapple Culture. 1. Soils.....	" 35

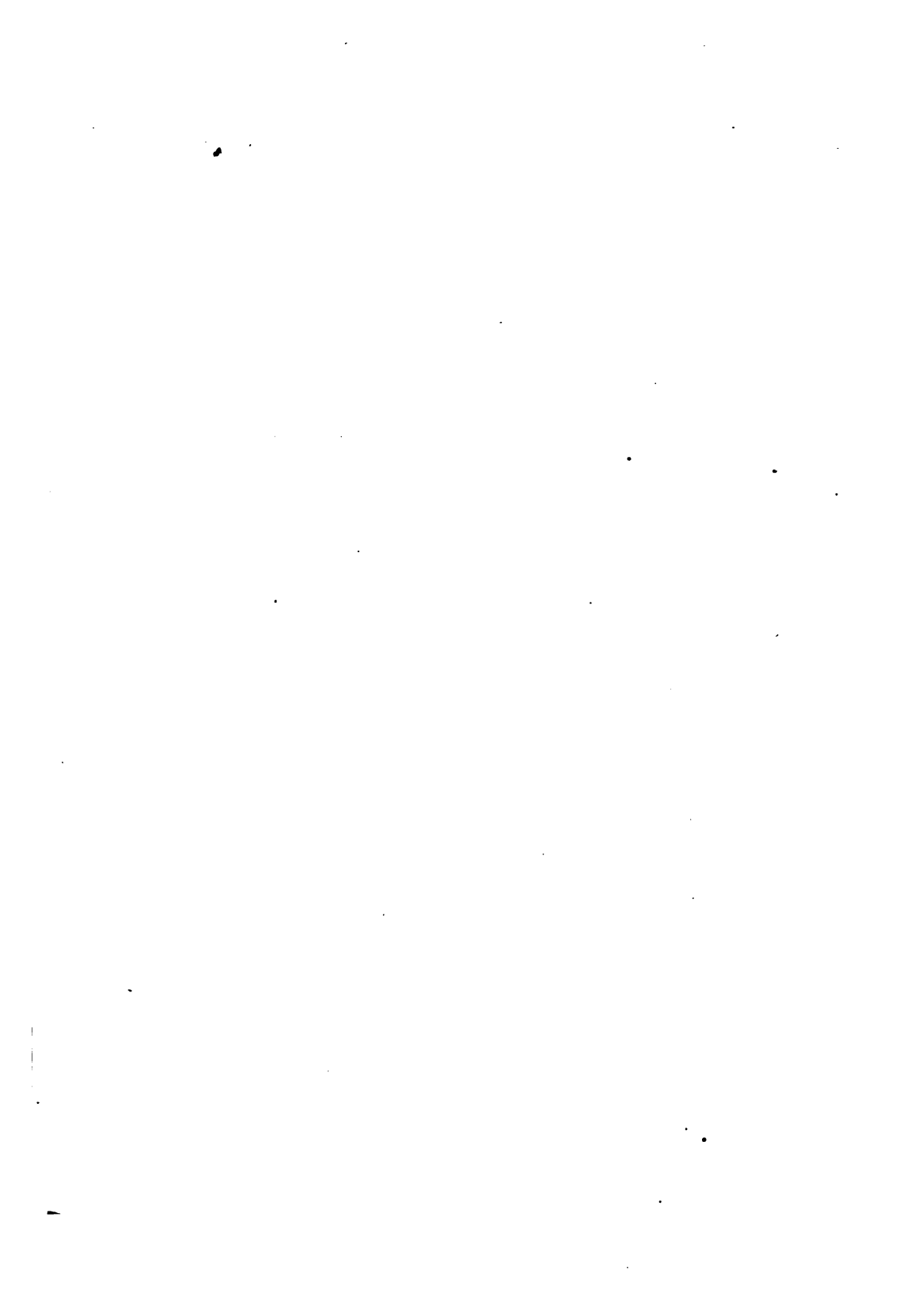
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PLATE I.



Poor and good Spring cultivation of Citrus Groves on high ground. Compare the rank growth of weeds in the former with the perfectly clean cultivation of the latter.



FLORIDA
AGRICULTURAL EXPERIMENT STATION

Pineapple Culture II. Varieties.



Fig. 1. Cayenne Pineapple Plant in Fruit.

By H. HAROLD HUME, and H. K. MILLER.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director at the Experiment Station, Lake City, Fla.

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Longitudinal Section through fruit of Cayenne Pineapple	Plate XIX.

Pineapple Culture, II. Varieties.

The pineapple belongs to the family Bromeliacæ commonly known as the Pineapple family. A number of its relatives are common in Florida, particularly in the southern portions of the State. Among these may be mentioned the Spanish, or gray moss, *Tillandsia usneoides* L., and nine or ten other species of *Tillandsia*, frequently referred to as Air plants. The species *usneoides*,



Fig 2. Flower of Spanish Pineapple.

referred to above, is found throughout Georgia, Alabama, Mississippi, Louisiana and Texas and in other portions of the South. So far as known the whole family Bromeliacæ is distinctly American, being found native throughout the tropical and sub-tropical regions of North, Central and South America. The pineapple belongs to the genus *Ananas* and is known botanically as *A. sativus* Schulte. It was described by Lindley under the name *Ananassa*, but the rules of priority give preference to the shorter name.

Description of the Plant.

The true stem of the pineapple plant is rather short and stout, the leaves are rigid, scurfy (particularly on the under side), rather upright and spreading, with margins usually serrated. The original upper portion of each plant bears but one fruit, but it is replaced by a sucker (branch) which develops from a bud in the axil of one of the lower leaves. Two or more of these suckers may develop and bear fruit, in which case, the lower portion of the original stem may have upon it a number of branches, each bearing fruit. The same identical portions of a plant or sucker never bear a second fruit. The lower portion remains, but the upper is replaced by a new branch.

The leaves are arranged spirally, spiny-pointed, and as noted above, usually serrated. They vary in length with the age of the plant and the conditions under which it is grown. From two to four feet represents the variations in length. The leaves are plentifully provided with strong fibre from which a fine quality of muslin-like cloth may be made. In this country nothing has

been done in the way of making use of this fibre for commercial purposes, but in the East considerable attention is paid to the manufacturing of cloth from pineapple fibre.

The stem bearing the flower is from three-quarters to one and one-quarter inches in diameter and six or eight inches in length. It bears, just below the flower head, eight to fifteen bracts. These are leaf-like and upwards merge into the eye bracts so that a gradual gradation may be traced from the leaves below to the bracts of the flowers and fruit above. The bracts below the fruit are usually brilliantly reddish-colored. In their axils, immediately beneath the flower head, buds are present which develop into the slips so commonly used in propagating the plant. The bracts at the upper end of the flower head develop so as to form the crown of the fruit. The flower stem is continued upward into the flower head and forms a receptacle upon which the flowers are set.

Each flower is subtended by a triangular bract, fleshy at the base, thin and papery toward the apex, and serrated. The eye of the fruit at maturity is partially covered by it. Beneath this bract are the three other parts of the perianth convolute in the bud. These parts of the perianth are thick and fleshy, pinkish at the tips, triangular in outline, 3-8x1-4 inch. The inner row of the perianth is violet or purple colored, the parts are oblong, three in number. The stamens are six in number, introrse. The style is single, three parted, while the ovary is three-celled and provided with numerous ovules.

The pineapple fruit is a sorosis, or a collective fruit formed by the cohesion into a solid mass of the ovaries and perianths.

In the cultivated pineapple, seed is seldom found, in one or

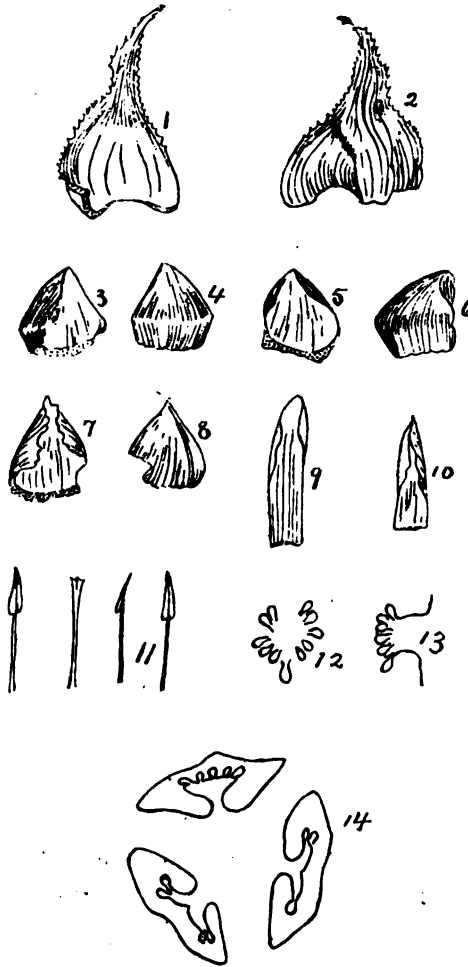


Fig 3. Parts of Pineapple Flower.

1 and 2, Inner and outer views of the eye bract, natural size; 3--8, inner and outer views of the three outer parts of the perianth, natural size; 9--10, two of the inner parts of the perianth; 11, stamens (enlarged); 12--13, ovules; 14 cross section of the ovary showing arrangement of the cells and ovules.

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PLATE X.



Fig. 1, Egyptian.



Fig. 2, Golden.

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Fig. 1, Pernambuco.

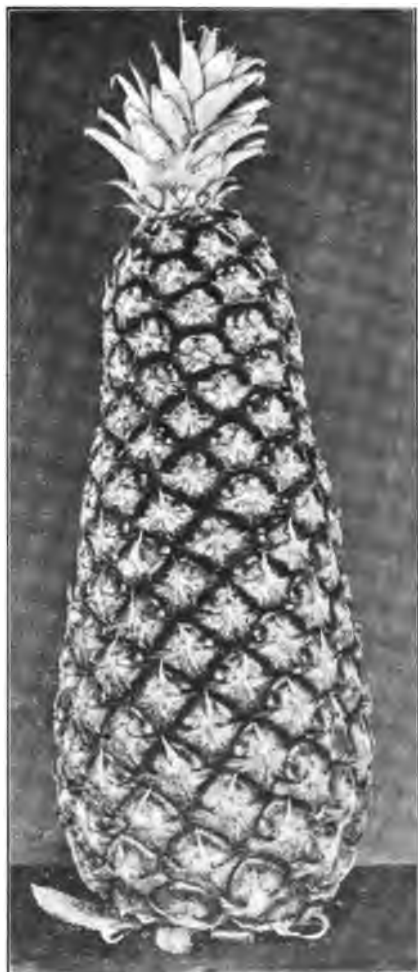


Fig. 2, Abachi.

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PLATE XII.

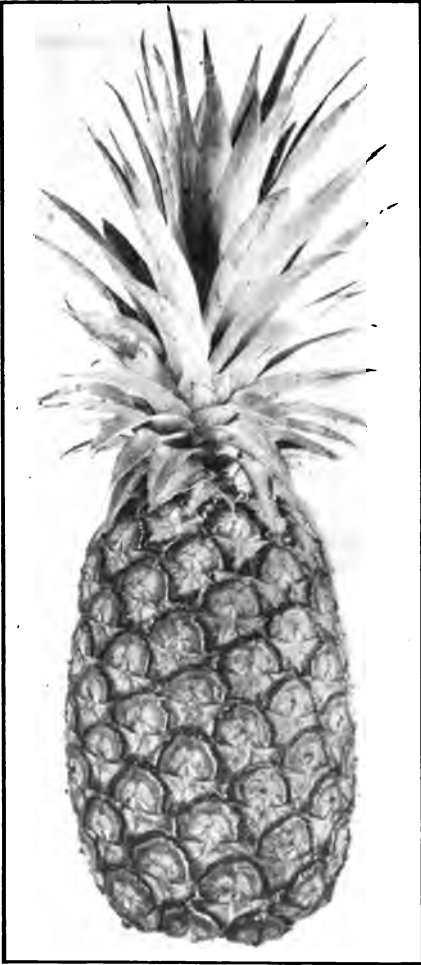


Fig. 1. Cayenne.

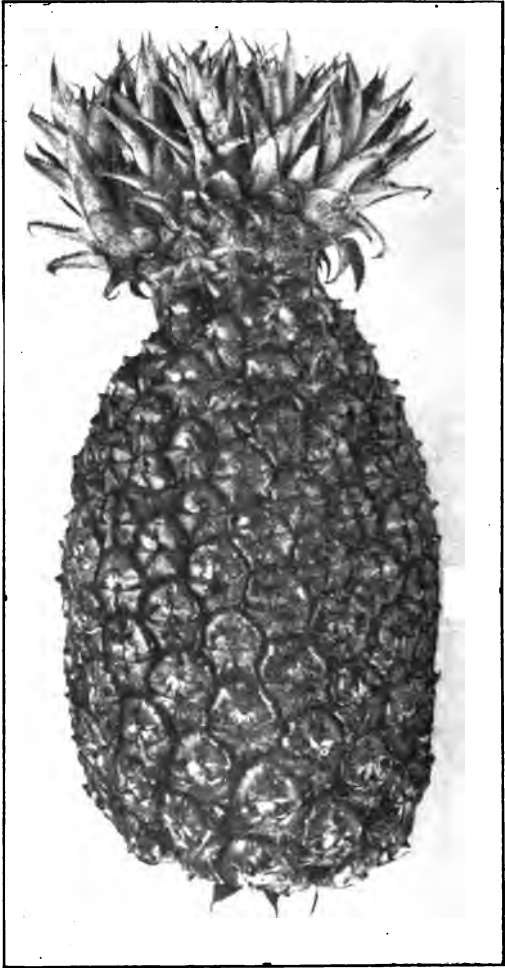


Fig. 2. Enville.

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Fig. 1. Rothchild.



Fig. 2, Blood.

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Fig. 1, Porto Rico

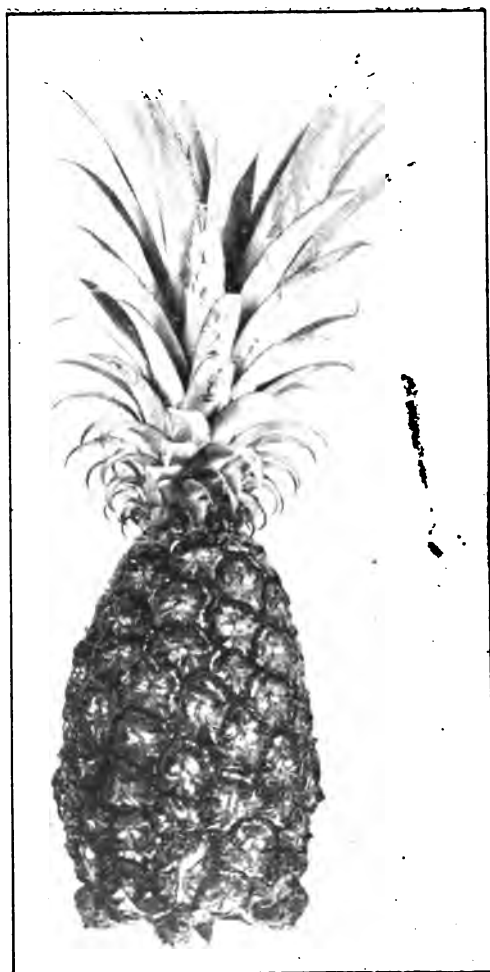


Fig. 2. Prince Albert.

1901

two instances it has been observed, however. The wild pineapple grown as a curiosity in this State is usually abundantly provided with seeds. Artificial pollination frequently results in the formation of seed. The seeds are small, brownish, roughened, and oval in outline.

Classification.

The only important classification of pineapple varieties hitherto advanced is that given by Mr. D. Munro in the Trans, London, Hort. Soc., Ser. 2, 1: 1-34, 1835. In setting forth the basis of his classification, Munro says:

"In order to facilitate their discrimination, I have first separated the kinds reputed to be species, which are readily known by their peculiar habits and I then distributed the varieties of *Ananassa Sativa*, or the true pineapples, in classes and divisions, characterized by such distinctions as have been found by experience most permanent. After much consideration it has been determined to employ the different degrees of serrature in the leaves as the primary mode of division, because it is they that cause in the greatest degree that natural habit of the varieties by which a practiced eye will recognize them without an inspection of fruit. The groups so formed are the least artificial that could be discovered, for the form of the fruit and the of the flowers, although excellent marks of distinction, separate varieties which are almost identical in their general habit; for this reason such characters have been admitted as only of secondary importance."

The classification in full as given by him is as follows:

Ananassa Sativa.

*Leaves spineless.

a. Flowers purple.

5. Havannah.

6. Smooth Havannah

b. Flowers lilac, nearly white.

Fruit globular.

7. Green Antigua.

Fruit pyramidal.

8. Striped smooth-leaved Sugar-loaf.

**Leaves with minute spines, (about 11 in an inch on an average).

- q. Flowers purple.
Fruit oval.
9. White Providence. 10. Green Java. 1. Black Jamaica.
Fruit cylindrical.
12. Orange Sugar-loaf. 13. Downton Havannah.
Fruit pyramidal.
14. New Jamaica.
b. Flowers lilac.
15. New Demerara. 16. Striped Surinam.
- ***Leaves with middle sized spines (about 6 or 7 in an inch on an average).
a. Flowers purple.
Fruit cylindrical.
17. Sierra Leone. 18. Ansons. 19. Montserrat.
20. Trooper's Helmet.
Fruit pyramidal.
21. Green Providence. 22. St. Vincent.
b. Flowers lilac.
Fruit cylindrical.
23. Globe. 24. Lemon Queen. 25. Otaheite. 26. Surinam.
27. Buck's Seedling Globe.
Fruit pyramidal.
28. Brown leaved Sugar-loaf. 29. Brown Sugar-loaf.
30. Mealy leaved Sugar-loaf. 31. Black Sugar-loaf.
32. Striped leaves Sugar-loaf. 33. Trinidad. 34. Black's Seedling.
35. Enville. 36. New Enville. 37. Spring Grove Enville.
Lord Bagot's Seedling. 39. Blithfield Orange.
- ****Leaves with large rigid Spines (about 4 in an inch on an average).
a. Flowers purple.
40. Black Antigua. 41. Welbeck Seedling. 42. Ripley.
b. Flowers lilac.
Fruit globular.
43. Russian Globe. 44. Russian Cockscomb.
Fruit cylindrical.
45. Queen. 46. Ripley's Queen. 47. Green Queen.
48. Moscow Queen. 49. Striped Queen.
50. Silver striped Queen. 51. Antigua Queen. 52. Blood Red.

This classification is full and complete, but has been found inapplicable for our purposes. It may be pointed out that in many cases the distance between the spines varies and, frequently even

on serrated varieties, leaves occur which have no serrations or on which a considerable portion of the margin is free from them. The number of serrations per inch depends too much upon the size and vigor of the leaf and the conditions under which it is grown. Hence we have decided to group the varieties in accordance with the characteristics of the fruit.

Heretofore, no attempt has been made by any American writer to divide the pineapples, cultivated in this country, into groups as has been done with nearly all other fruits. No one, acquainted with the peculiarities of the different varieties, will fail to realize that they are easily divided into a number of groups. Of course, in any system of grouping, it is sometimes difficult to at once decide where the fruit should belong. This is particularly true when all are horticultural varieties of the same species, as is the case with the pineapple. After carefully studying the characteristics of the different varieties, it has been decided to divide them into the Queen, the Cayenne, and the Spanish groups, characterized as follows:—

. *Queen Group—The typical variety of this group is the Golden pineapple. The fruit is characterized by yellow flesh, pointed eyes sloping upward from the sides, deep yellow fruit and syrupy juice, flavor rich and sweet. Plants usually not adapted to open field culture.

**Cayenne Group—The Cayenne, commonly known throughout the State as Smooth Cayenne, may be regarded as the type of this group. The flesh is a light yellow, the eyes broad and flat, not elevated at the nipple. The leaves are smooth or serrated, the plants are strong, up-right, vigorous growers.

***Spanish Group—The typical variety of this group is the

Spanish pineapple. The flesh is white, the eyes are flat but elevated at the corners of the bracts. The leaves are strong, stiff and serrated.

Varieties

At the present time no variety of pineapple in general cultivation has been originated in this state. All of the varieties now in general cultivation or which have been cultivated at any time, have been introduced from Brazil, the West Indies, India, or from the green houses of England. Many varieties at one time grown in the state have now disappeared from cultivation and specimens of them cannot at this time be secured in Florida. Despite this fact, the catalogue list of the State Horticultural Society, which is identical with that reproduced in Bulletin No. 8, Division of Pomology, U. S. D. A., has remained unchanged. If we retain the following varieties: Spanish, Cayenne, Abachi, Porto Rico, Egyptian and Golden, we have a list which comprises all the pineapples now grown commercially in Florida. Others, such as Rothchild, Prince Albert, Enville, Black Ripley, Green Ripley, Giant Kew, Pernambuco, and many others have entirely or almost entirely disappeared from cultivation. They have, at one time, been grown in the state but have been discarded because they were not suited to our conditions or they have been superseded by better varieties. Fully 95 per cent. of the pineapples grown in this state are of the Spanish variety, while more than 99 per cent. of all the plantings are Spanish, Cayenne, Abachi, Porto Rico, and Golden varieties, and for commercial purposes, this list contains practically all the varieties.

For extensive open field culture, the Spanish pineapple is the

only variety which can be recommended. Cayenne, Abachi, Porto Rico and Egyptian may be grown in a small way in the open field but plantations of these varieties are too short lived to prove remunerative as compared with the Spanish. For growing under sheds, Cayenne, Abachi, and Golden are given the preference and of these Cayenne is evidently the best. Porto Rico may be grown in a small way in the open field and in the shedded pinery for decorative purposes.

***Queen Group.**

Black Ripley—Size medium, weighing from 2 to 5 pounds, 5 1-2x4 1-8 inches; form oblong, tending somewhat to conical; color orange yellow; crown of medium size, 4x4 inches; leaves broad, short, thickly set on the axis, sharp pointed, reddish, spiney, the spines reddish in color, basal bracts, reddish, spiney, thin; eyes prominent, size small, 11-16x11-16 inch, rectangular in outline, gradually elevated from the margin to the nipple, 110 in number; eye-bracts covering about one-third of the eye, tapering to a sharp point, thin, the point extending above the nipple; flesh creamy yellow in color; flavor sweet and rich; juice abundant; quality excellent; core one-half to three-quarters inch across; season July.

Described from specimens secured from W. Pomeroy, Eldred, Fla. Before ripening this variety has a black green color, hence the name. The characteristics are those of the green Ripley. It is of no commercial importance and has disappeared from cultivation.

Egyptian, Plate x. Fig. 1.—Size medium, 6 7-8x4 1-16 inches, weighing from 2 to 4 pounds; form oblong, tapering slightly; deep yellow in color; crown of medium size, 6x4 1-2 inches, upright

rather spreading, leaves not stiff, abruptly pointed, spiney; basal bracts green, slender, very sharp pointed; stem one inch in diameter; eyes prominent, pointed, gradually elevated from the edges to the nipple, small, 7-8x3-4 inch, 138 in number; eye bracts rather fleshy, pointed, reaching to the nipple; flesh rather open, firm, not stringy, yellow in color, sweet, of excellent flavor; juice abundant, syrupy; core 3-4 inch in diameter; season June-July.

Described from specimens received from Hardee Bros., Jensen, Fla.

The Egyptian (Queen) pineapple is supposed to have been first grown by Capt. Burnham at Cape Canaveral, Fla., and its true name is supposed to be Cleopatra. The fruit is of excellent quality and when grown in the open field somewhat earlier than Spanish. It commands good prices in the market, but is subject to disease. It fruits well and is prolific of both slips and suckers, but is gradually disappearing from cultivation.

Golden (Golden Queen) Plate x. Fig. 2.—Size large, weighing from 4 to 8 pounds, 7x5 1-16 inches; form oblong, tapering, bulging slightly above the base; color deep yellow; crown of medium size, rather spreading, the leaves spiney, broad at the base, tapering rather abruptly; basal bracts yellow, thin, tipped with a spine; eyes prominent, 1 1-8x7-8 inches, sloping upward from the sides so as to make the eye somewhat conical shaped, 132 in number; eyebracts fleshy, with a small point not reaching to the nipple; flesh solid, juicy, comparatively free from fiber, deep yellow in color; flavor sweet; juice syrupy; quality excellent; core one inch across: season July-September.

Described from specimens received from C. S. Van Houten, Orlando, Fla.

The Golden Queen is grown principally in the shedded pineries at Orlando, where the number of plants of the variety is second in number to the Cayenne. The fruit is of excellent quality.

Green Ripley—Size medium, weighing from 2 to 5 pounds, 5 1-2x4 1-8 inches; form oblong, tapering slightly toward the apex; color yellow; crown medium in size, forming a rosette, 3x4 inches, leaves short, broad, sharp pointed, finely serrate, tapering abruptly, green; basal bracts whitish or greenish, sharp pointed; eyes small, 5-8x3-4 inch, pointed, elevated from the sides to the middle, 109 in number; eye bracts covering one-half to one-third of the eye, abruptly pointed, point sharp, extending just about the middle; flesh yellow in color, rather open; sweet and acid, well combined, juicy; quality very good; season July.

Described from specimens received from W. Pomeroy, Eldred, Fla.

This variety is very closely related to the Black Ripley, their general characters being the same.

Pernambuco Plate xi, Fig. 1.—Size small, weight one to three pounds, 5 1-2x3 3-8 inches, 6x3 1-4 inches; form oblong, sloping slightly to the crown; color yellow; crown of medium size, narrow, upright, about 8 inches long, leaves spiney, the spines on the smaller ones being set almost at right angles to the leaf; basal bracts pinkish; eyes well defined, elevated slightly from the margin to the nipple, 3-4x5-8 inch, upper portion roundish, lower rectangular, angles blunt; bracts covering about one-third or one-half the eye, the point fitting tightly against the nipple; flesh yellow in color, juicy; flavor rich; quality excellent; core very small; season July-August.

Described from specimens received from the Riviera Pinery, West Palm Beach, Fla.

The Pernambuco pineapple is not surpassed in quality by any other variety of pineapple. It is frequently spoken of as the standard in quality among pineapples. Introduced from Brazil.

[Abachi (Abbakka, Abbachi), Plate xi, Fig. 2.—Size variable, good large specimens weighing from 4 to 6 pounds, 9x5 inches; form oblong, typical specimens tapering upward from base to crown; color deep yellow; crown usually distinctly necked, strict and upright, six inches to one foot high, leaves small, narrow, rather abruptly pointed; basal bracts reddish, thin, lanceolate; eyes of medium size, 1x7-8 inch, somewhat circular in shape, flat; nipple rather blunt; eye bracts covering nearly 1-2 the eye, the point thin, just reaching to the nipple; flesh yellowish, containing but little fibre; flavor rich, sweet, juice abundant; in quality one of the best of pineapples; core, 3-4 to 7-8 inch across, season June-September.

Described from specimens received from C. T. McCarty, Eldred, Fla., and from fruits purchased in the market at Lake City, Fla.

This pineapple, as already noted, is of excellent quality and for home use is quite desirable, but too frequently it does not carry well to market. With the first crop nearly 100 per cent. of the plants will bear fruit but the second crop is rather irregular and the plants do not stand up well. An objectionable feature of this variety is the production of slips in the basal eyes of fruit. These must be broken out shortly after the plant blooms, else the base of the fruit will be injured.

Cayenne—(Smooth Cayenne). Plate XII, Fig. 1. Size large,

good specimens weighing from 5 to 8 pounds, 7 3-4x5 5-16 inches to 8x5 1-4 inches; form oblong, tapering very slightly, occasionally with a tendency to become conical; color yellow; crown when well developed about 9 1-2x8 inches, spreading, leaves without serrations, sharp pointed, tapering gradually to the apex; basal bracts green with slight tinge of pink, sharp pointed and broad at the base, tapering gradually to the apex; eyes 1 3-16x1 1-8 inches, broad, flat, very slightly elevated at the nipple, 98 in number; eye bracts tipped with a small, narrow point covering the nipple; flesh firm, yellowish in color, very juicy; flavor rich and sweet; core small, 3-4 inch across; season June-August.

Described from specimens received from Cyrus W. Butler, St. Petersburg, Fla., C. T. McCarty, Eldred, Fla., L. de Gottreau, Boca Ratone, Fla.

The Cayenne pineapple is the variety most commonly grown under sheds in Florida, particularly at Punta Gorda, St. Petersburg and Orlando. It is also the variety most commonly grown in Hawaii and the Azores. It is an exceedingly fine variety and is the best of the fancy pineapples. It has not proved sufficiently well adapted to soil conditions in Florida to render it desirable for open field culture, being too subject to *Fusarium* blight.

Enville, Plate XII. Fig. 2.—Size large, good specimens weighing from 4 to 6 pounds, 8 1-2x5 1-8 inches; form oblong, tapering slightly from above the middle of the crown; color deep yellow; crown usually composed of a number of short, stubby crownlets grouped so as to form a rosette, 2 1-2x5 1-2 inches, the leaves serrated, small, compressed and upright; basal bracts, thin, pinkish; stem small; eyes medium to small, 13-16x7-8 inch, roundish or blunt angled, flat, with the nipple rather depressed than promi-

nent, 162 in number; eye bracts covering about one-half the eye, the points small, thin, extending to the nipple; flesh very open, meaty and comparatively free from fibre; color light yellow; flavor sweet, but somewhat lacking character; juice plentiful; quality rather inferior, the flesh frequently containing a number of black eyes; core one inch across; season, about August.

Described from specimens received from Mr. C. Van Houten, Orlando, Fla. The Enville pineapple has been almost entirely discarded, the fruit as noted above being too frequently spotted with dark specks about the eyes.

Rothchild (Charlotte Rothchild). Plate XIII. Fig. 1.—Size, small to medium, 6 1-2x4 1-2 inches, weighing 4 to 6 pounds; form oblong, tapering very slightly toward the crown; color deep yellow; crown well developed and of medium size, 8 1-2x6 inches, rather upright, leaves spiney, serrate, tapering, green above, grayish below; basal bracts pinkish, tapering, sharp pointed; stem of medium size; eyes medium to large, 1 1-2x1 1-4 inches, 11-8x1 1-8 inches, flat, the nipple slightly elevated, blunt; eyes rounded at the upper side, the lower portion bluntly three-angled, 84 in number; eye bracts fleshy, spreading laterally well beyond the eyes, apex small, not reaching to the nipple; flesh firm, whitish, of fair quality; core 3-4 to one inch in diameter; season August.

Described from specimens received from C. S. Van Houten, Orlando, Fla.

This variety is unimportant and has disappeared entirely from cultivation.

***Spanish Group.

Blood Plate XIV. Fig 1.—Size small, 5x4 1-4 inches; form oblong; color bright, reddish-yellow; crown well developed, 7x6

inches, spreading, leaves rather long, 3-4 inch wide, spines reddish; eyes resembling those of Spanish, of medium size, 1x3-4 inch; flat, nipple small, slightly elevated, 78 in number; eye bracts covering half the eye, abruptly pointed, the point reddish, projecting to the nipple; flesh white, firm, juicy, quality rich; core 3-4 inch in diameter; season, July.

Described from specimens received from C. T. McCarty, Eldred, Fla.

The Blood pineapple is a very handsome little fruit of excellent quality. Its small size is against it, however, and it is not cultivated to any extent.

Porto Rico. Plate XIV. Fig. 2.—Size very large, sometimes weighing as much as 12 to 15 pounds, 9 1-2x6 1-2 inches, 12x6 1-4 inches; form broad at the base, the sides sloping upward, frequently bulging irregularly; color yellow, dark green before ripening; crown large and spreading, leaves not stiff, broad, tapering abruptly, spiny, serrate, the spines pinkish colored; basal bracts thick, spiny pointed; stem 1 1-2 inches across, usually breaking up into the fruit at the time of gathering to obviate which the fruit must be cut from the plant; eyes large, 1 1-2x1 1-4 inches, irregularly rectangular in shape, broad, flat, or slightly elevated toward the nipple, with the projecting rectangular part below, 152 to 156 in number; eye bracts large, covering nearly one-half the eye, fleshy, the point projecting to the nipple; flesh solid, though somewhat open, very fibrous, yellowish white in color; flavor sweet, juice abundant; quality fair; core 3-4 to 1 inch across; season June-July.

Described from specimens received from J. E. Balis, Braidentown, Fla., C. T. McCarty, Eldred, Fla., and the Riviera Pinery, West Palm Beach.

This variety is the largest pineapple cultivated in Florida and though inferior to many others as a desert fruit, its large showy appearance makes it quite desirable and valuable for decorative purposes. It contains a very considerable amount of fibre. Good specimens pack about eight or ten to a crate.

Prince Albert. Plate XV. Fig. 1.—Size medium to large, weighing about 5 pounds, 7x4 1-2 inches; form oblong, tapering to the crown; base square, a number of the lower eyes usually develop into small slips; color yellow, crown well developed of medium size, 9x7 inches, upright and spreading at the top, leaves lanceolate, sharp pointed, serrate, spiney, the spines purplish; basal bracts pinkish, small, tapering; stem of medium size; eyes medium, 1 1-8x1 1-4 inches, flat, irregularly angled, depressed somewhat about the elevated nipple; eye bracts fleshy, covering one-half the eye, point small, reaching to the nipple; flesh containing a medium amount of fibre, whitish in color; flavor sweet; quality very good; core one inch across; season August.

Described from a specimen received from C. S. Van Houten, Orlando, Fla.

This variety is not cultivated in Florida, the only specimens known to the writer being a few in Mr. Van Houten's pinery at Orlando.

Red Ceylon. Plate XV. Fig. 2.—Size medium, 6 1-2x5 1-8 inches, weight 2 1-2 to 4 pounds; form oblong, rounded at the base, sloping abruptly to the crown; color dark green before ripening, deep yellow when ripe; crown of medium size, 7x4 1-2 inches, rather strict, spreading toward the top, leaves broad at the base, tapering to the apex, serrations reddish, upper sides of the leaves a reddish tint; basal bracts tapering pinkish; eyes rather large,

15-16x13-16 inches, flat, nipped, closely resembling those of the Spanish, 123 in number; eye bracts covering one-half the eye, fleshy, pointed, the apex reaching above the nipple, flesh white, fibrous; quality medium; core 5-8 inch in diameter; season July-August.

Described from specimens received from C. M. Mathews, West Palm Beach, Florida.

This specimen was introduced from Ceylon at the same time as the Yellow Ceylon pineapple and as yet untasted.

Sugar Loaf Plate XIII. Fig 2.—Size small to medium, weighing from one and one-half to four pounds, 5 1-2x4 inches, 7 1-2x4 3-4 inches; form oblong-conical tapering slightly from base to crown; color deep yellow; crown well developed, spreading, the leaves large, spiny serrate, thin, not stiff, spines about ten to an inch; basal bracts colored pinkish, long tapering, spiny pointed, very thin; stem small; eyes rather small, 3-4x7-8 inch to 3-4x1 1-16 inches, general outline oval tending to roundish, being rounded above and blunt angled below, flat, depressed about the nipple, 110 in number; eye bracts fleshy at the base, pointed, extending just above and covering the nipple, not spiny tipped; flesh rather open, containing little fibre, yellow in color; flavor sweet, sprightly, juice abundant; quality quite good; core 1-2 to 3-4 inch across; season August-October.

Described from specimens received from C. T. McCarty, Eldred, Fla., J. E. Balis, Braidentown, Fla.

At the present time the Sugar Loaf pineapple is not cultivated to any considerable extent in Florida. The constitution of the plant does not admit of its being grown extensively in outdoor culture.

Spanish. Plate XVI. Fig. 1. (Red Spanish, Black Spanish,

Key Largo, Scarlet Key, Largo, Havana, Cuban, Strawberry.) Size, medium, weighing from 2 to 5 pounds, 5 3-4x4 5-8 inches, 5 1-4x4 1-8 inches; form oblong or sometimes sloping a very little toward the apex from a point somewhat below the middle; color yellow, sometimes distinctly reddish; crown 4 to 7 inches long, stiff, upright, crownlets frequently present, leaves spiney, rather short, the spines small, 8 to the inch almost parallel with the sides of the leaves; basal bracts lanceolate, reddish, or reddish spotted with yellow; stem about one inch across at the base of the fruit; eyes well defined, 3-4x7-8 inch, 1-8x1 1-4 inches, rather rectangular, flat, elevated at the angles, nipple well defined, short and blunt, rather variable in number, 77 to 92; eye bracts well developed, covering about one-third of the eye, the point projecting to the nipple, comparatively free from fibre; color white; flavor sweet, pleasantly mingled with acid, character well developed; juicy; quality good; core 3-4 inch across; season June-August.

Described from specimens received from C. T. McCarty, Eldred, Fla., and the Riviera Pinery, West Palm Beach, Fla.

The Spanish pineapple is the variety most commonly grown in Florida, 95 per cent. of the plantings being of this variety. In the East Coast pineapple regions it is planted almost entirely. The quality of the fruit is very good, and although it might be improved, the healthy, vigorous constitution of the plant makes it the most desirable variety for extensive open field culture.

Yellow Ceylon. Plate XVI. Fig. 2.—Size, medium, 5 3-4x4 1-2 inches; form oblong, sloping abruptly both ways from the middle; base rather depressed about the stem; color yellow, light green before maturing, with yellow tipped bracts; crown very large, 11-1-2x11 inches, spreading; leaves coarsely serrate and spiney, not stiff, outer ones wide at the base, triangular in outline;

basal bracts light straw colored, stem 1 inch in diameter; eyes large, flat, resembling those of the Spanish, 111 in number; bracts large, projecting laterally beyond the eyes, covering one-half or more of the eye, tip covering the nipple; flesh yellowish, rather acid, containing a considerable amount of fibre, juicy; quality fair; season, July-August.

Described from specimens received from C. M. Mathews, West Palm Beach, Florida.

This variety is a recent introduction and its merits have not been fully tested in this state.

***Miscellaneous.

Wild Honduras. Plate XVII. Fig. 1.—Size small, 4 1-2x3 5-8 inches; shape oblong, shouldered; color whitish yellow; crown very large, 17x11 inches, rather upright, spreading, the leaves are broad, 1 1-4 to 1 1-2 inches wide, spiny serrated spines large from 1-4 to 3-8 inches apart; basal bracts large, pinkish, spiny; stem large; eyes small, 1x3-4 inch, rounded at the top, angled below, beak rather prominent, elevated, the eye depressed around it. 68 in number; eye bracts fleshy, long, pointed, broad, extending beyond and covering the nipple, 1 1-4 inch from base to apex; flesh very fibrous, stringy, whitish, flavor acid and disagreeable; not very juicy; quality worthless; core large; seeds present, brown, slightly rough, about three to each eye; 3-16 inch long.

Described from specimens received from C. Van Houten, Orlando, Fla., and Riviera Pinery, West Palm Beach, Florida.

This variety is quite interesting as it evidently comes nearer the primal type of the pineapple than any other variety now cultivated in the State.

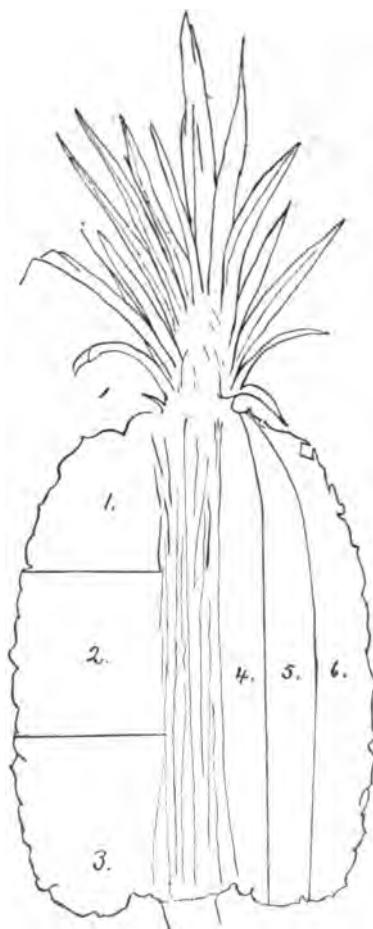


Fig. 4. Diagram of Parts. See Table III.

Composition of Different Varieties.

Analyses were made of twelve of the different pineapples described, in order that the differences in quality of these varieties

PLATE XV.



Fig. 1. Red Ceylon.

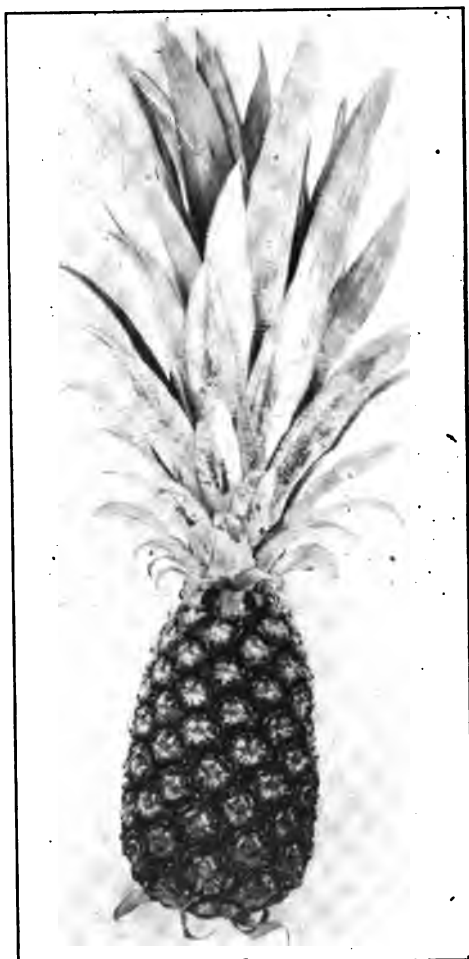


Fig. 2. Sugar Loaf.

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PLATE XVI.



Fig. 1. Spanish.

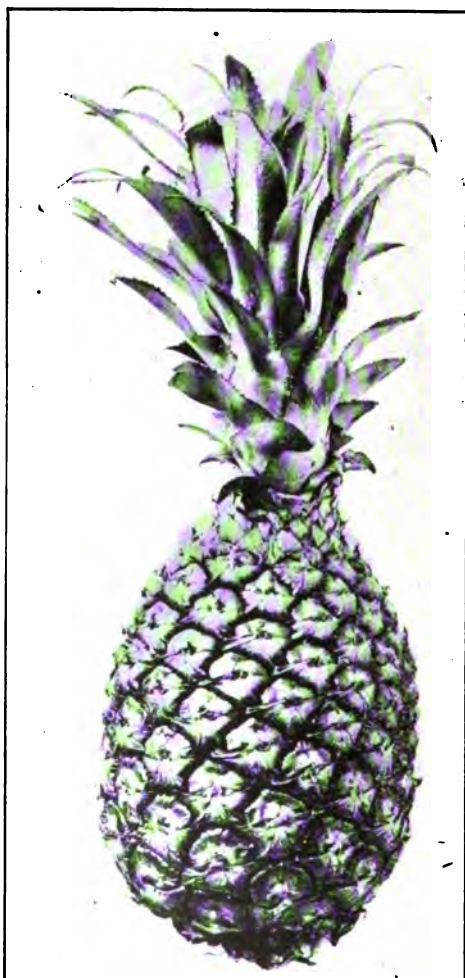


Fig. 2. Yellow Ceylon.

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PLATE XVII.



Wild Honduras Pineapple.

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PLATE XVIII.



Cross-Section of the Fruit of the Cayenne Pineapple.

8700

PLATE XIX.



Longitudinal Section through fruit of Cayenne Pineapple.

Mr. U

PINEAPPLE CULTURE. II. VARIETIES.

might be better understood. The methods employed were essentially those given in Bulletin 65, Bureau of Chemistry, under Fruits and Fruit Products, though there was some variation in matters of detail. The fruits were prepared as for serving, the weight of each fruit recorded, together with the amount of waste, which included the core, crown and parings. The percentage of edible portion of each variety was determined and the figures are given in Table 1.

TABLE I.
Proportional Parts of Different Varieties of Pineapples.

Laboratory Number.	VARIETY.	Weight of Fruit		Weight of Parings		Edible Portion	
		Ounces.		Ounces.		Per Cent.	
393	Abachi.....	40	17	65.3	34.7		
394	Spanish.....	59	24	59.3	40.7		
395	Cayenne.....	78	29	62.8	37.2		
396	Red Ceylon.....	58	25	57.0	43.0		
397	Egyptian.....	29	14.5	50.0	50.0		
398	Golden.....	55	19	65.4	34.6		
399	Porto Rico.....	48	48	57.0	33.0		
401	Enville.....	66	28	57.5	42.5		
402*	Prince Albert.....	44	17	61.8	38.2		
404*	Sugar Loaf.....	38.7	16.5	57.3	42.7		
405*	Rothchild.....	40.5	14.75	63.5	36.5		
406*	Wild.....	23.5	11.75	50.0	50.0		

Care was taken to select for analysis, specimens as nearly as possible of the same degree of ripeness and of such size as to represent a medium fruit of its variety, so that the weights given may be taken as representing what one may expect as an average sized fruit of its kind. It will be seen from the above that there is a variation of from twenty-nine to one hundred and forty-six ounces in weight of single fruits of the varieties represented. From the descriptions, it will be noted that there is a great difference in size of fruits of the same variety. This is especially true

of the Porto Rico, Cayenne, Spanish and others, but there is greater uniformity with varieties which are naturally small, such as the Egyptian and Golden.

The percentage of edible portion of a fruit is an important item. In pineapples of the same variety the waste is much greater from a small fruit than from a large fruit, but aside from this we find considerable variation in the percentage of waste in fruits of similar dimensions, but of different varieties. The amount of waste is determined by three factors, the size of the core, the weight of the crown, and the depth to which the eyes penetrate into the fleshy portion of the fruit. According to the results in the above table, the edible portion varies from fifty to sixty-seven per cent. The high percentage to the credit of the Porto Rico is to a great extent due to the large size of the fruit. Yet a Cayenne of this weight would doubtless have not more than twenty-five per cent. of waste. This is borne out by the results obtained by H. H. Cousins, who found that the percentage of edible fruit from a ten pound Porto Rico was 63.1, while a seven and one-half pound Cayenne contained nearly 86 per cent. of edible fruit. (Bulletin of the Department of Agriculture, Jamaica, Vol. 1, Part II.)

The percentage of waste must necessarily be large in the small varieties of pineapples like the Egyptian and this places such at a disadvantage for market purposes which quality, no matter how excellent, can scarcely overcome.

The character of the crown of a fruit has no little influence on its market value. Fruits with diminutive crowns, besides being difficult to pack so as to carry well, are less appreciated by the purchaser on account of their appearance. There is less waste, however, in such fruits.

TABLE II.

Analysis of the Edible Portion of Different Varieties of Pineapples.

Laboratory Number.	VARIETY.	Total Solids Per Cent.	Soluble Solids Per Cent.	Ash Per Cent.	Nitrogen Per Cent.	Available Juice Per Cent.	JUICE.					
							Acid as H ₂ SO ₄ Per Cent.	Reducing Sugars Per Cent.	Conc. Sugar Per Cent.	Total Sugars Per Cent.	Direct Reading.	Invert Reading.
398	Abachi.....	11.98	11.40	0.41	0.066	80.7	1.05	8.00	7.18	10.55	6.4	2.86
394	Spanish.....	12.64	11.44	0.46	0.063	87.2	1.35	2.18	7.64	10.22	6.7	3.08
395	Cayenne.....	14.40	13.38	0.42	0.089	85.5	0.60	4.05	8.86	13.37	8.4	3.08
396	Red Ceylon.....	10.61	8.64	0.43	0.076	80.0	1.03	2.31	5.15	7.73	4.5	2.20
397	Egyptian.....	16.00	14.01	0.48	0.062	74.6	0.81	2.31	9.41	12.21	8.6	3.68
398	Golden.....	13.27	12.16	0.42	0.067	86.6	0.62	8.55	8.01	11.98	7.2	3.30
399	Porto Rico.....	13.60	11.22	0.47	0.069	87.5	0.76	2.76	8.41	11.61	7.2	3.74
401	Enville.....	12.45	11.16	0.61	0.074	79.4	0.59	2.24	7.92	10.57	7.5	3.64
402	Prince Albert.....	13.66	12.25	0.69	0.061	84.3	1.19	1.81	9.07	11.35	8.2	3.41
404	Sugar Loaf.....	10.78	9.76	0.48	0.065	85.6	2.11	1.96	6.22	8.49	4.7	3.30
405	Rothchild.....	9.90	8.76	0.57	0.083	84.9	1.28	2.14	4.28	6.64	3.1	2.42
406	Wild.....	10.51	6.77	0.75	0.190	78.5	2.00	1.86	2.30	4.28	1.8	1.21

In table II, is given the results of the analysis of the edible portion of the different varieties. The solids and ash were determined from the grated fruit after mixing. The nitrogen was determined from sliced sections taken in such manner as to represent a fair sample of the edible part of the fruit. Duplicate determinations were made in all cases and very concordant results were obtained. The sliced fruit, after weighing, was transferred to a six hundred c. c. Jena flask, mercuric oxide and sulphuric acid added, and the determination completed as usual. This method of procedure has proven much more satisfactory than when the fruit is dried previous to making the analysis. The percentage of available juice was found by squeezing a weighed portion of the flesh in a cloth bag and weighing the juice yielded from pressure by hand. Nothing is claimed for this, as it is obvious that like conditions could not be had with different samples.

The sugars and acids were determined in the juice as it is al-

most impossible to get a sufficiently uniform sample of the grated fruit for this purpose. The percentages of these constituents in the juice will vary somewhat but not a great deal, from the percentages of these in the edible portions of the fruit in as much as the total juice represents 96 to 99 per cent of the material.

Disregarding flavor, the quality of a pineapple is determined by the amount of insoluble solids, the percentage of acid, and the kind and quantity of sugars present. The insoluble solids approximately represent the fibre of the fruit and how this affects the relish with which the fruit may be eaten is well understood by those who are familiar with the different varieties of pineapples. The high esteem in which such varieties as the Abachi, Sugar Loaf and Cayenne are held is largely due to the small amount of fibre they contain, as indicated by the analysis. The Golden, Spanish, and Enville are among those that contain rather more fibre, and while they are excellent fruits, they fall short of the delicate nature of the ones first mentioned. The Porto Rico which is well known on the American market, belongs to that class which is high in fibre and is, by many, chiefly prized for decorating purposes on account of its size. This variety contains more than two per cent of fibre and this detracts very much from its usefulness as a table fruit.

At this point it may be well to call attention to the fact that a pineapple should be served in slices cut parallel with the core and not perpendicular to it, since the fibres radiate from the core to the surface. See plates XVIII and XIX.

There is a great variation in the quantity of sugars and acids in fruits of the same variety since these constituents are much in-

fluenced by the conditions under which the fruit is grown. It is well understood that a pineapple which ripens during the winter or early in the spring is much more tart than one which ripens in summer. A Spanish which matured in winter was found to contain 1.30 per cent. acid, 1.89 per cent. reducing sugars, and 5.06 per cent. cane sugar. These figures compared with the ones in the table for this variety show the winter grown fruit to contain less sugars by nearly three per cent., while the acid content is about the same for each.

We see from the figures in table II that the amount of acid varies from .59 to 2.11 per cent., the cane sugar from 2.30 to 9.41 per cent. and the reducing sugars from 1.81 to 4.05 per cent. Attention is called to the fact that those varieties which are low in acids are usually high in sugars and those high in acids are rather low in sugars.

No standard can be fixed in the matter of what constitutes a proper ratio between the amounts of acid and sugars, as there is such a difference in taste. Some prefer the Cayenne for its sweet taste and lack of acidity, while others object to it for the same reason. It is interesting to note that the Spanish, which is the great market pineapple of this country contains acids and sugars in quantities which are not far from the averages of the others.

The sugars and acids were determined in the juice of sections taken from different parts of a Porto Rico pineapple as indicated by the drawing, Fig. 4. The results are given below:

TABLE III.
Cane Sugar and Acids in Sections of a Porto Rico Pineapple.

FIGURE 4.	Acids as H ₂ SO ₄ Per Cent.	Cane Sugar Per Cent.	Direct Reading.	Invert Reading.	Temperature, C.
Section 1.....	1.27	6.57	5.5	3.08	27°
Section 2.....	0.84	9.30	8.4	3.74	27°
Section 3.....	0.70	9.87	8.7	4.18	27°
Section 4.....	0.63	11.08	9.8	4.62	27°
Section 5.....	0.66	9.65	8.2	4.40	27°
Section 6.....	0.91	6.88	5.8	3.19	27°

From the above it is readily seen that the composition of different parts of the fruit is not the same. The sugars decrease and the acid increases as we ascend from the base to the crown and the same is true passing from the core to the circumference. It follows that the portion of the fruit near the core at the base of the pineapple is the sweetest.

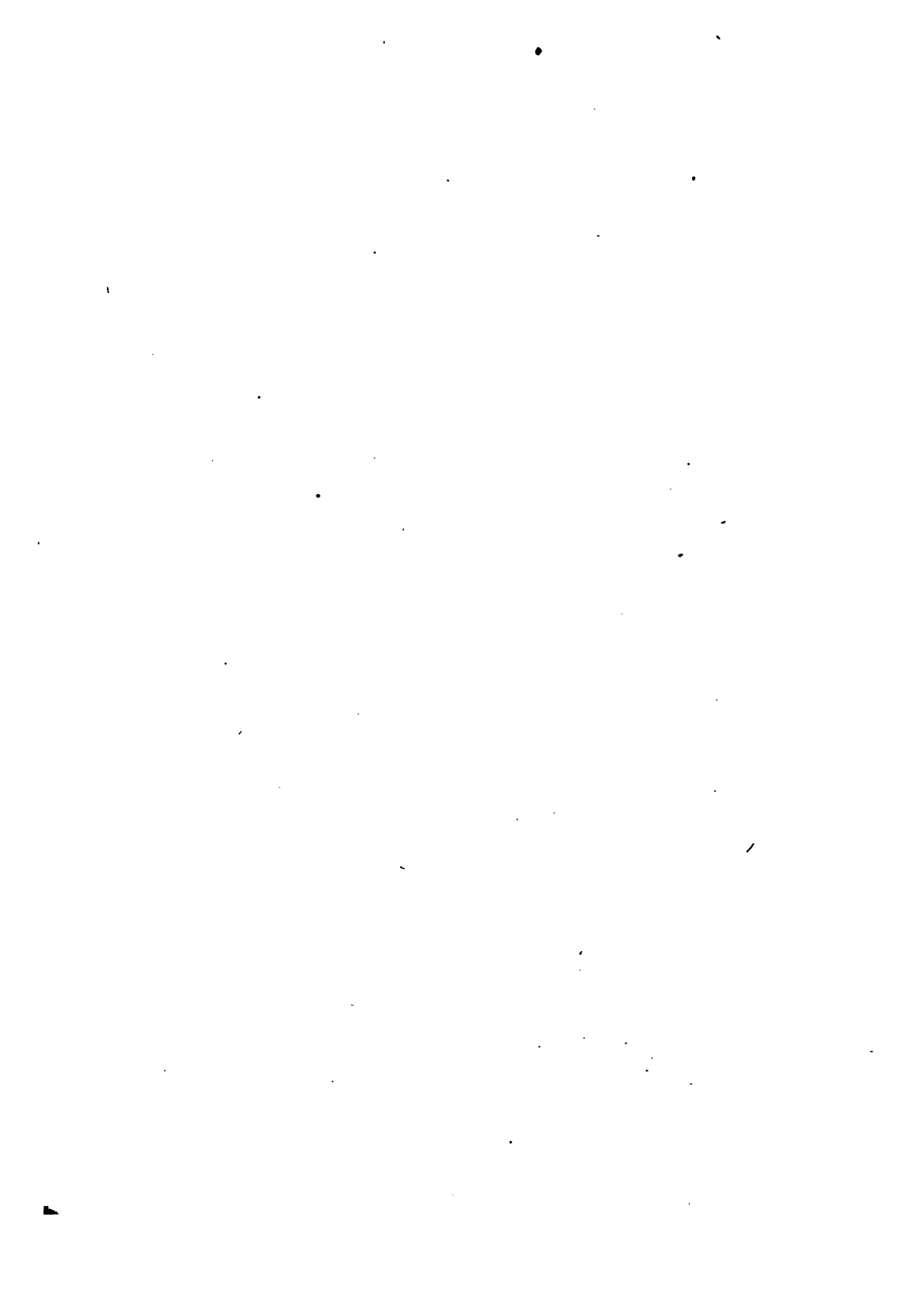
The analysis of the Wild is given to show how by culture and selection the undesirable features of the pineapple have been removed and desirable qualities increased. The Wild contains nearly four per cent. of fiber and two per cent. of acids, while there is little more than two and one-fourth per cent. of cane sugar present.

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BULLETIN NO. 71

MARCH, 1904.

FLORIDA
AGRICULTURAL EXPERIMENT STATION

Japanese Persimmons.



TSURU PERSIMMONS IN FRUIT ON STATION GROUNDS.

By H. HAROLD HUME and F. C. REIMER.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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Japanese Persimmons.

Introduction.

Since its introduction into this country a little more than a quarter of a century ago, the Japanese persimmon or Kaki, has been slowly but steadily growing in favor. Throughout the Southern States, where it can be placed on the market when nearly ripe, there has been and is always a good demand for the fruit, sufficient to make it profitable to cultivate it in a limited way. In the northern markets, however, it has not met with the favor that it was expected to receive. The reason for this, perhaps, lies in the fact that it comes into the markets with apples, pears and late peaches. Besides this, it must be shipped before fully matured, and being placed on the fruit stands while still unripe, the purchaser's first impression of it has too frequently been everything but favorable. Delicious though the fruit is when fully matured, there is nothing more repellent than a green, or half ripe, light-fleshed Kaki.

Though it cannot be grown extensively for shipments outside of the State, the local demand is good and will increase. For home use, few fruits surpass the Japanese persimmon and no garden should be without a few trees.

History of the Japanese Persimmons.

Kaki, or the Japanese persimmon, is a native of Japan, Corea and parts of China. There it has been growing wild in the forests from time immemorial. It is a delicious fruit in the

wild state, as it grows in Japan, hence the Japanese have taken a great fancy to it, even in its unimproved condition. The persimmon is to the Japanese what the orange is to the Floridian. This love for the fruit even in the wild state soon created a desire for its cultivation and improvement.

The persimmon has been cultivated for centuries in Japan. There it has received more care and attention than any other Japanese fruit. It has been improved to such an extent that there are now many varieties. The Japanese serve and preserve it in many different ways. Various methods of preserving and curing them are in use. In fact, this fruit is now to Japan what the apple is to the United States. It is their national fruit.

There is almost no literature to be found on the Japanese persimmon in this country. Several reasons may be given for this fact. First, it is a comparatively new fruit. Second, there are only a few sections in this country where it can be grown successfully. Third, people must learn to like the fruit, hence there has been no market for the fruit until recently. Fourth, until a short time ago, the value of the fruit was not known in this country. It is somewhat difficult to trace its introduction into the various Southern States.

In 1863, the Department of Agriculture became interested in the Japanese persimmon and a large number of seeds were sent to the Department by the American Legation in Japan. These seeds were sown in the open ground. The plants grew well that season, but as the following winter proved to be a severe one, most of them were killed. Several other importations of seeds were made, but with the same unsatisfactory result, although some of the varieties proved to be more hardy than others.

As a result of these attempts the idea that the Japanese

persimmon could be successfully introduced by seed was given up. It was then thought that if the young trees of the hardiest varieties could be secured, the introduction might prove successful. This was done, but the severe winter following again killed the trees.

Then budding and grafting the hardiest Japanese varieties on the American species, *Diospyros Virginiana* was attempted. The budding proved to be unsuccessful. The grafted trees did well during the growing season, but in the severe winter which followed they were killed. This discouraged the Department and the idea of introducing the Japanese persimmon was given up for some time.

About 1875, a large number of trees were imported by the Department and by private parties, and were sent to nearly all of the Southern States. These importations proved successful, and since then the Japanese persimmon has been planted in nearly every State in the South, and is now a fruit of considerable importance both for market and home use, especially the latter.

Kizo Tamari, in the Report of the Michigan State Horticultural Report for 1886, says: "Mr. S. Truda was the first to import our persimmon (*D. Kaki*) into this country; he tells me that the importation cost him considerable pains, and he further states that the fruit was not appreciated at first by the Americans at Tokio, being discarded in America as not eatable; but at present the fruit is well known by every pomologist in this country and is called the Japanese persimmon."

Varietal.

Botany and Description. The persimmon belongs to the family *Ebenaceae* or Ebony family. There are five or six genera

in this family. The persimmon belongs to the genus *Diospyros*, which contains over 150 species. Only two species are cultivated, i. e., the American species, *D. Virginiana*, and the Japan persimmon, *D. Kaki*. *D. Virginiana* is perhaps the most widely distributed species of the genus; representatives of it are found from the Great Lakes to the Gulf of Mexico. It is particularly



Fig. 2. Hachiya Persimmon tree.

abundant in the Southern States. This is of considerable importance in growing Japanese persimmons, as will be seen further on.

The tree of the Japanese persimmon varies a great deal in size and shape. In Japan, the wild tree often attains a height of from 40 to 50 feet. Under cultivation the tree is considerably smaller and has a more spreading habit than that of the wild one. Heavy bearing, while the tree is young, also dwarfs it to a great extent.

Flowers are solitary or in clusters, small, greenish-white in color; calyx generally four lobed, rarely three or five lobed; corolla four to six lobed; stamens many, anthers introrse; styles two to six in the pistillate flowers.

The leaves are extremely variable, both in size and shape. They are oval, ovate, oblong and elliptical. Apex acute or obtuse; base acuminate, acute, obtuse or truncate. Margin is entire. Size of leaf, length two to eight inches, width one and five-eighths to three and one-half inches; petiole one-half to three-fourths inch long.

Fruit. No fruit varies more than the persimmon in form, size, color, flesh, flavor, color of flesh, number and form of seeds, texture and thickness of skin.

In form they are round, quadrangular, slightly or strongly oblate, oblong, conical, strongly pointed, or a combination of two or more of these forms. In size they vary from one and one-half by one and three-fourths to three and three-fourths by three and one-half inches. In weight from a few ounces, as Zengi, to over a pound, as some specimens of Hachiya and Tanenashi.

The color is not so variable as some of the other characters, especially when the fruit is dead ripe, yet at the picking sea-

and pointed. The number of seeds varies from none to eight. There are eight seed cavities, but we seldom find more than six seeds in one fruit. Some varieties, as Tanenashi and Hachiya, are known as "seedless varieties," yet one or two seeds are often found in some specimens. The ripening season of the different varieties ranges from the first of September to the last of November.

Varieties. Had greater care been exercised at the time of introduction, the nomenclature of the Japanese persimmons would not have been in such a chaotic condition, as it now is. Varieties were introduced under assumed English names and further introductions of the same varieties were made under the Japanese names. Furthermore, many of the Japanese names were simply local ones and frequently the same variety was imported under two or three different names; hence, the confusion. Most of the varieties now cultivated in this country are, as their names would indicate, of Japanese origin, and it is unfortunate that greater care was not taken to secure the proper varieties under their correct names at the time of introduction.

The most noteworthy work that has been done in straightening out the nomenclature of these fruits is that of Prof. H. E. VanDeman, formerly pomologist of the United States Department of Agriculture. The work done by Professor Van Deman has been practically accepted by all Horticulturists.

In the United States Department of Agriculture museum there is a collection of models of Japanese persimmons which was exhibited at the World's Fair at Chicago in 1893. The following is the list of varieties: Goshō, Hyakume, Goshō-Maru, Yeddo-ichi, Chinese, Dai-dai-maru, Arukaya, O-anzai, Myotan, Kanro, Giboshi, Mishiradzu, Tsuru-no-ko, Yaman, Tsuruoko, Nita-

ri, Zengi-maru Hassaku, Kaku-yemon, Hachiya, Shime-shiradzu, Saijo, Gronbo, Yemon Takura, Tane-nashi, Kaku-maru, Okame, Oni-maru, Midzu-hachiya—twenty-nine varieties in all. A glance at this list will illustrate the fact that some of the difficulties of our nomenclature of this fruit may have arisen from the fact that many of the names are compound and connected by a hyphen. In some cases, as for instance, Kaku-maru and Oni-maru, we have a combination that might, through mistakes in spelling, or by omission of a portion of the name, lead to a great deal of trouble. Herein we see the wisdom of the determination of the American Pomological Society to exclude names of this type from our pomological lists.

Some time previous to 1891 the Japanese Agricultural Society, of Tokio, Japan, published a large chart illustrating the fruit, cross-sections of the fruit and in some cases the seed of forty-five varieties of Japanese persimmons. It was accompanied by a folio of descriptions and notes. The list of varieties is as follows: Tsuru-no-ko, Tankin-Dzuru, Yama-Dzuru, Ko-Tsuru, Shimo-maru, Kumosu-maru, Tane-nashi, Tengu, Shibu-Tsuno-magari, Tsuno-magari, Masugata, Hachiya, Shimo-Shiradzu, Okame, Yemon, Nitari, Hiyakume, Dai-dai-maru, Goshio-Goki, Goshio-Hira, Goshio-maru, Yeddo-ichi, Zengi-maru, Denji-maru, Kabuo-Goki, Kow-shin-maru, Toyama, Giboshin, Miyotan, Higaki, Ditto, Abura-Tsubo, Hakojaki, Koshibu, Aoso, Gionbou, Soijio-Goki, Kintoki-maru, Hetaguro, Shinano-gaki (*D. lotus*).

The illustrations are sufficiently clear and the descriptions lucid enough to make it possible to determine each variety with a fair degree of accuracy. It is strongly recommended that this chart and folio, and the models in the museum of the United

States Department of Agriculture be taken as the foundation of our nomenclature. Furthermore, it is deemed advisable to drop all hyphens and this policy has been adopted in this publication.

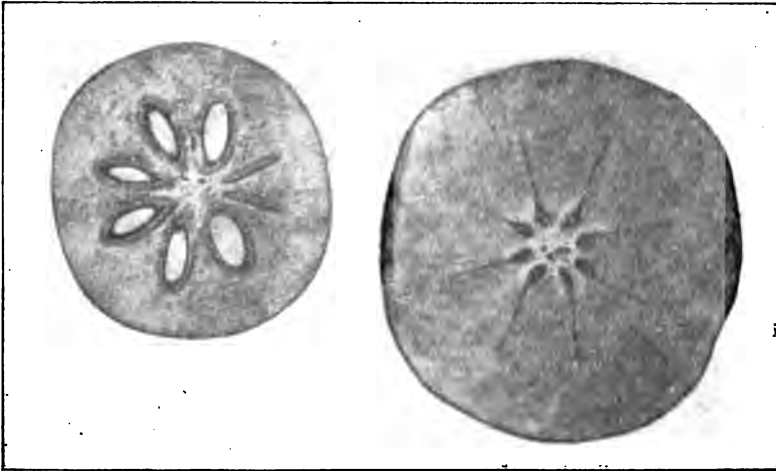


Fig. 4. Cross sections of fruit, Triumph and Hachiya.

After considerable study of the subject, it has been decided to group the varieties into light-fleshed, dark-fleshed and mixed. As a general rule, it may be said that dark flesh and seeds accompany each other, though Triumph is an exception to this rule, and occasionally when seeds are found in light-fleshed varieties, dark spots about the seeds are usually present. Unfortunately there are no other characteristics of the plant which constantly accompany the differences in the color of the flesh of the fruit. It might be mentioned here, as already noted, that in the case of varieties in which seeds are found there is always a correlation between the shape of the fruit and the shape of the seed. Oblong, pointed, or conical varieties have seeds much longer than

broad, while oblate varieties have broad, or roundish seeds. Based upon the distinctions in the color of the flesh the varieties may be grouped as follows:

*Light-fleshed varieties: Costata, Hachiya, Phelps, Tane-nashi, Triumph, Tsuru.

**Dark-fleshed varieties: Hyakume, Myotan, Nectar, Yedoichi, Zengi.

***Mixed-fleshed varieties: Godbey, Maru, Okame, Tabers No. 23, Tabers No. 129, Yemon.

* Light-Fleshed Varieties.

Costata. Form distinctly conical, pointed, one side larger than the other; size medium to large, 2 1-8x2 5-16, to 2 5-16x2 3-4 inches; color reddish, when dead ripe deep red with heavy purple bloom; cavity deep and irregular; apex a long, sharp point; stem stout and curved, one-half inch; calyx large, thick and tough, recurved; skin smooth, tough and very thin; flesh firm, heavy, granular, cartilage-like around seed cavities; color, whitish yellow, brownish in vacant seed cavities; seeds few, one or two, long, oval, large, 14-16x9-16 inch, color dark brown, nearly seedless; season October; grown at the University of Florida.

Trees strikingly upright, tall; bark grayish-brown; number of fruits on average five-year-old tree, 95 to 100; leaves oval, base acute, apex acute, size 6 5-10x3 3-8 inches; petiole, 3-4 inch long.

Hachiya. Form oblong, slightly pointed; size, very large, 3 3-4x3 1-2 inches; color reddish yellow, apex end bright red, surrounded by sparse, irregular, grayish lines; cavity deep and wavy; apex slightly pointed, black point on end; stem very stout, curved, 5-8 inch; calyx large, adhering closely to fruit; skin smooth, medium thick; flesh astringent until thoroughly ripe,

firm, granular, creamy yellow in color; seeds one, often seedless, lanceolate, long, 1 1-8x3-8 inch, color light brown; season October 15 to 30. Obtained of G. L. Taber, Glen St. Mary, Fla.

Leaves oval, apex obtuse, base acute; leaf 3 3-4x2 3-4 inches; petiole, 5-8 inch long. Tree large and spreading.

Phelps. Form spherical; size small, 1 5-8x1 9-16 inches; color lemon yellow, becoming reddish and covered with bluish white bloom as it softens; cavity shallow, irregular; apex a small, black



Fig. 5. Hachiya, natural size.

point; stem medium stout, curved, 1-2 inch long; calyx large, deeply lobed; skin smooth and tough, medium thick; flesh solid, slightly

granular, reddish-yellow in color; seeds three or four, elliptical, slightly triangular, large, 3-8x7-16 inch, color light brown. Season, October. Obtained of Mr. G. L. Taber, Glen St. Mary, Fla.

Fruit borne in clusters, leaves elliptical, apex acute, base acute, 3 1-4x1 3-4 inches; petiole, 1-2 inch long. This is one of the few light-fleshed varieties that have seeds.

Tanenashi. Form round, slightly pointed; size large, 2 1-2 x3 1-8 inches; color bright, light red, with a few irregular cracks about apex; cavity deep, slightly red, apex pointed; stem medium stout, 1-2 inch long; calyx large, adhering closely to fruit; skin leathery and thin; flesh solid, rather granular, light yellow in color; seeds none; season October. Grown at the University of Florida.

Tree medium in size, strongly upright, top slightly spreading; bark dark gray; leaves oval-elliptical, apex and base acute, 5 1-4 x3 1-4 inches; petiole 5-8 inch long.

Triumph. Form strongly oblate, slightly four-sided; size small, 1 1-2x2 3-8 inches to 1 3-4x2 1-2 inches; color reddish yellow, with a few grayish cracks about the apex; cavity medium deep; apex a small black point; stem long, rather stout, calyx large, deeply four-parted, recurved; skin smooth, except about apex, medium thick; flesh firm, slightly yellow, dark about seeds; seeds six or seven, nearly oblong, 9-16x6-16 inch, thick, dark brown; season October. Grown at the University of Florida.

Tree medium in size, upright, spreading, rather compact; bark grayish-brown; very prolific; leaves elliptical, apex acute, base acuminate, size 4x1 5-8 inches; petiole 1-2 inch long.

Tsuru. Form distinctly conical, pointed; size medium, 2 1-2 x2 1-4, 2 3-4x2 1-2, 2 7-8x2 13-16 inches; color yellowish red, changing to very dark red as it softens, with heavy purple bloom; cavity

very shallow; apex a long, sharp point; stem stout, 1-2 to 5-8 inch; calyx large, medium thick, recurved; skin rough, rather thick; flesh sweet, granular, solid, dark yellow in color; seeds three,



Fig. 6. Tanenashi, natural size.

lanceolate, large, long, 11-2x3-8 inch, light brown in color. Season middle of October to middle of November. Grown at the University of Florida.

Tree upright, spreading, medium to large; bark grayish-brown; leaves ovate-elliptical, base and apex acute; size 5x2 1-2 inches, petiole, 5-8 inch. Very prolific. A light-fleshed variety, but has seeds.

**** Dark-Fleshed Varieties.**

Hyakume. Form nearly spherical, apex end flattened; size medium, 2 1/4 x 2 7/8 inches; color light red with many brownish cracks about the apex; cavity deep, grooved; apex a slender, sharp projection; stem medium stout, curved, 5-8 inch long; calyx large, rather thin; skin smooth, except a small area about the apex, very thick; flesh sweet, fibrous, solid, dark, filled with many brownish black specks; seeds six, elliptical, slightly kidney-shaped, large, 5/8 x 1/2 inch, brown; season October. Grown at the University of Florida.

Tree upright, spreading, large branches grayish, twigs reddish brown in color; leaves ovate, base acute, apex obtuse, 5 3/4 x 2 7/8 inches, petiole 1-2 inch. Medium prolific.

Miyotan. Form roundish oblate, slightly pointed; size small to medium, 1 11/16 x 2 5/16, 1 5/8 x 2 1/8 inches; color dull red; bloom present; irregular grayish-black cracks about the apex; cavity very shallow, reddish yellow; apex a black point, four wide depressions radiating from it; stem short, curved and very thick; calyx medium, adhering to fruit; skin puckery, leathery, thick; flesh firm, breaking, dark, except a very thin layer just beneath the skin and about the seeds; seeds five or six, oval, flat, large, 7/8 x 1/2 inch, color light brown; season November. Obtained of P. J. Berckmans Co., Augusta, Ga.

Nectar. Form oblong, pointed; size small, 2 1/8 x 2 1/8 inches; color light reddish yellow, dark red near apex, bright; cavity very shallow, dull yellow in color; apex a black point; stem long and stout; calyx large, adhering close to fruit; skin smooth, leathery in appearance, medium thick; flesh medium sweet, solid, dark, filled with many reddish black specks; seeds five, long,

7-8x5-16 inch, rather thick and plump, light brown in color; season October. Obtained of D. L. Pierson, Monticello, Fla.

Yeddoichi. Form roundish oblate, slightly pointed, size medium, 21-8x21-2 inches; color light red, covered with dark dots; cavity rather deep, wide, slightly irregular; apex a small black point; stem stout, curved, 3-8 inch long; calyx medium, quite thick; skin smooth, medium thick; flesh sweet, granular, seed cavities filled with a gelatin-like flesh, yellowish white in color; seeds oval, slightly pointed, large, 13-16x9-16 inch, brownish in color, tendency to seedlessness; season October 15th to November 15th. Grown at the University of Florida.

Tree small to medium, open, branches drooping, bark grayish-brown in color, shy bearer; leaves oblong, apex acute, base truncate, 51-2x31-2 inches, petiole 1-2 inch long.

Zengi. Form roundish oblate; size very small, 12-8x113-16 inches; color dull reddish-yellow, with brownish cracks about the apex; cavity very shallow; apex a brownish point; stem thick, curved, 3-8 inch long; calyx medium, well lobed; skin leathery, very thick; flesh stringy, compact, dark throughout; seeds generally eight, slightly kidney-shaped, rather triangular, 11-16x3-8 inch, dark brown; season October. Grown at the University of Florida.

Tree, large, upright, spreading; bark grayish brown in color; leaves elliptical, apex acute, base truncate, 4x21-2 inches, petiole 3-8 inch long. A heavy bearer.

*** Mixed-Fleshed Varieties.

Godbey. Form strongly oblate, grooved about the apex; size large, 15-8x31-4 inches; color yellowish red, deeper red about the apex; cavity deep, four-grooved; apex slightly sunken, with a black point; calyx medium thick and tough; skin smooth, very

thin; flesh sweet, compact, granular with mixed color, bright yellow beneath the skin with dark center; seeds five, oval, 13-16x5-8 inch, brown in color; season October 15th to November 1st. Obtained of T. K. Godbey, Waldo, Fla.

T. K. Godbey, of Waldo, Fla., the originator of this variety, makes the following statement in regard to it:

"During the big freeze all of the persimmon trees I had were killed to the ground except this one. It went through without the loss of a twig. I had about all of the imported varieties at that time."

Maru. Form roundish-oblate, or sometimes slightly pointed, depressed apex; size small to medium, 2.1-2x2.1-2 inches; color bright, dark red with heavy purple bloom; cavity deep, irregular; apex strongly depressed, with sharp, black point; stem 3-8x1-2 inch long, stout and curved; calyx large, lobes distinct, not reflexed; skin very uneven tinted with markings particularly around the base and up about half way, thin; flesh solid, somewhat granular, color mixed, bright yellow near the skin, dark in center, dark flesh extending nearer skin on one side than on the other; seeds four to six, slightly oval, one side nearly straight, 13-16x7-16 inch, dark brown in color; season October 15th to November 15th. Obtained of P. J. Berckmans & Co., Augusta, Ga.

This variety is distinct from Yeddoichi as propagated in Florida.

Okame. Form oblate, four-sided, grooved about the apex; size large, 2x3 inches; color dark yellow; cavity large, with many deep grooves radiating from it; apex a black point; stem stout, slightly curved, 1-2 inch long; calyx medium in size, adhering to fruit; skin smooth, medium thick; flesh solid, heavy, decidedly stringy, light yellow in color, dark about seeds, becoming reddish

as it softens; seeds broad oval in shape, large, 3-4x9-16 inch, chocolate brown in color, variable in number; tendency to seedlessness; season October. Grown at the University of Florida.

Tree medium in size, compact grower, upright, spreading, bark light gray.

Leaves 5x3 inches, ovate, base truncate, apex acute, petiole 5-8 inch long. Shy bearer.

Tabers No. 23. Form strongly oblate, slightly four-sided; size small, 1.1-2x2.3-8 inches; color light red with apex surrounded by small rough grayish lines; cavity small, shallow, slightly wavy; apex a black point; stem medium long and stout, curved; calyx large, thick, deeply four-parted; skin smooth and stipple marked and rather thick; flesh sweet, stringy, jelly-like about seeds, dark in color, with innumerable brownish-black specks; seeds six to eight, oval, size 5-8x1-2 inch, brown in color; season September 15th to October 15th. Grown at the University of Florida.

Trees small and spreading. Leaves broadly elliptical, apex acute, base obtuse, size, 6x2.3-4 inches, petiole 5-8 inch long.

Tabers No. 129. Form strongly oblate, slightly four-sided; 1.7-8x2.1-2 inches; color yellowish red, a few black specks on surface and irregular grayish cracks about the apex; cavity medium deep and uneven; apex slightly pointed; stem medium thick, 3-8 inch long; calyx medium in size, adhering closely to the fruit; skin smooth except about the apex, thin; flesh mixed, solid, rather granular, light yellow beneath the skin, dark and light mixed in the center; seeds five, nearly triangular, 3-4x3-8 inch, brown in color; season September 15th to October 15th. Grown at the University of Florida.

Tree upright; bark grayish brown. Leaves elliptical, apex

acute, base acute, 5 1-4x2 7-8 inches, petiole 1-2 inch long. A good bearer.

Yemon. Form oblate, distinctly four-sided; size medium, 2x3 inches; color dark red, base yellowish red, apex surrounded by grayish-black lines; cavity medium large with two marked depressions; apex a small black point; stem short and stout; calyx large, deeply four-parted; skin smooth, slightly resembling leather, thin; flesh very sweet, soft, a jelly-like coating about seeds and in seed cavities, color mixed, light yellow near skin, dark in center; seeds four, elliptical, large, 7-8x1-2 inch, brown in color; season October. Grown at the University of Florida.

Tree medium in size, spreading; grayish-brown in color; leaves ovate, apex and base acute, 4 1-2x2 2-3 inches; petiole 9-16 inch long.

Varieties Recommended for Planting. It is rather difficult to say just what variety, or varieties, should be planted. With persimmons, as with every other fruit, every planter has his personal tastes. One person may have a decided preference for a variety and he may be successful with it, while his neighbor may be equally successful with another variety, because he likes that variety. For home use several varieties should be planted, ranging from the earliest to the latest. For this purpose, the following list would be a good one: Yemon, Tanenashi, Zengi, Costata, Triumph and Tsuru. For commercial purposes the season at which the different varieties could be shipped has no advantage as the early varieties as well as the late ones come into competition with other fruits in northern markets. The early varieties come into competition with the late peaches and grapes, and the late varieties with apples and early oranges. The following is considered a good list to select from for commercial purposes: Yemon, Tabers No. 129, Tanenashi, Hachiya, Hyakume, Costata, Triumph and Tsuru.

Propagation.

Trees may be secured from two sources: by buying them from the nurseryman or each grower may grow stocks and scions and propagate his trees at home; that is, the farmer may have a small nursery of his own. Each source has some advantages and also some disadvantages; each source also has some strong advocates.

If trees are secured from nurseries, often they are not true to name and the propagating work may not have been well done; this is true principally when nursery trees are bought from so-called peddlers and unreliable nurseries. Then, too, the conditions of climate, soil, etc., under which the trees have been grown in the nursery are different from those on the farm where they are to be planted. Sometimes this has a tendency to check the tree. Yet this is not very important with the persimmon as the trees are very hardy and will grow on almost any soil. Then by securing trees from the nursery a person may gain from one to three years in time. This is very important when a grower wishes to get his orchard into bearing as soon as possible. To be sure, when one has no persimmon trees to begin with, nursery trees must generally be resorted to. Three points should be kept well in mind when buying nursery stock: first, never buy from unaccredited peddlers; second, always buy from a reliable nursery; third, buy the best trees that can be obtained.

The home grown trees also have advantages and disadvantages. The propagating work is often done by inexperienced hands and in many cases proves a failure. Scions are indiscriminately selected with a poor tree as a result. The advantages of a home grown tree are numerous if the work is properly performed. The young trees are grown under conditions which are identical with those under which the bearing trees are to grow. Then too, the desired variety can be propagated, but most important of all, the

grower can propagate the individual tree. Every orchard has one or more trees which are superior to other trees belonging to the same variety. These are the trees which should be propagated. There should be no doubt as to what constitutes the best trees. The best tree is not simply the one which bears the most fruit, for the fruit may be of inferior value. Nor is the best tree the one which bears the largest specimens for the yield may still be small. In general, it may be said that the best tree is the one which is least affected by disease and year after year bears the largest number of standard sized specimens of good quality.

Stocks. There are two kinds of stocks on which persimmons may be grown: Japanese persimmon seedlings or seedlings of the American persimmon, *D. Virginiana*. Both are good, but for Florida and for all the United States, the native persimmon furnishes by far the best stock. It is more vigorous and so gives a larger tree than does the Japanese stock. This is an important point as the tree is inclined to be rather dwarf when grown in Florida. The presence of the American persimmon, as a native tree in Florida, is good proof of the fact that Florida conditions are well suited to it, and hence it makes a good stock. Then, too, the seeds can be easily secured; and as they are plentiful, only the best seeds of the healthiest and most vigorous trees may be selected, and lastly, only the best seedlings. Many of the native persimmon trees can, and should be, top grafted with Japanese varieties.

Seedlings for Stocks. The seed of the American persimmon should be planted in a seed bed and not in the nursery row as is often done. After the seedlings have attained a height of say ten or twelve inches, transplant them to the nursery row. In the nursery, the rows are placed about two feet apart and the plants are placed six inches apart in the row. While in the nursery row, they

should be grafted. After the graft is well established, the trees are transplanted to the field where they are to remain. This transplanting them twice is of great importance as it gives the trees a better root system. More laterals are formed and a good compact system is the result. When the seed is planted in the nursery row and then the trees into their permanent place in the field, a poor root system is developed: a long tap root with few laterals.

Scions. The subject of scions is the most important one connected with the propagation of trees. The value of the trees depends almost entirely upon the scion; and the value of the scion depends entirely upon the tree from which it is taken.

The greatest scrutiny should be practiced in the selection of scions. First, decide upon a variety which you wish to propagate. Then study the individual trees of that variety. Study the quality of the fruit, healthfulness, vigor and productive power of the trees. After giving these points careful study, select the trees which come nearest to your ideal. Then select your scions from these trees. Select them from that part of the tree which bears the most and best fruit; generally this is on the branches most exposed to the light and sun. The scions should be from four to six inches long and should not exceed one-half inch in thickness. If possible the scion wood should not be cut until just before the grafting is done; or, if it is cut in the fall, it should be stored in sphagnum during the winter.

Grafting.

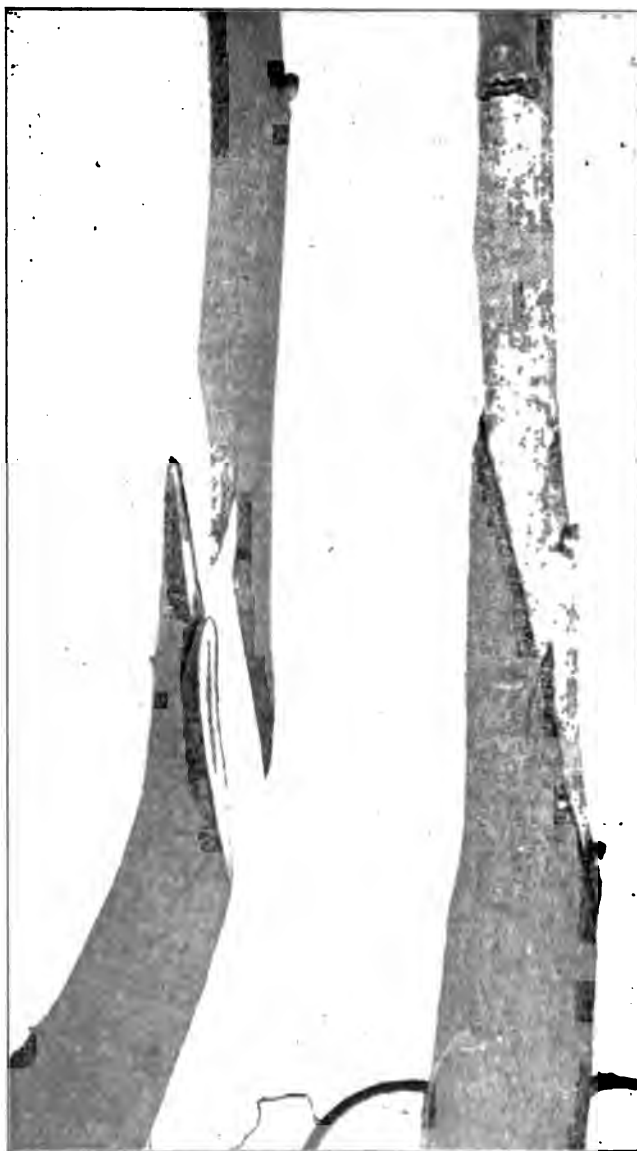
In Florida, persimmon trees are propagated by grafting. Crown grafting is so much superior to root grafting that the latter should never be employed in Florida. Two methods of crown grafting are used: cleft-grafting and whip-grafting.

Cleft-grafting. This method has been quite extensively used in grafting, due to the fact that the work is so easily performed. The operation is very simple and requires but very little skill. Furthermore, this method can be used on large stocks, while whip grafting can be practiced only on stocks not exceeding one-inch in diameter. Cleft-grafting is nearly always employed in top working persimmons and its greatest value is for this purpose. Cut the stock off squarely at the place where it is desired to place the scion. Then with a grafting knife, split the stock through the center and place the scions on each side of the stock so that the cambium layers will be in close contact. The scion should be sharpened at the lower end and the side which is to be in contact with the cambium of the stock should be somewhat thicker than the inner edge, making it wedge-shaped, with the thin edge on the inside. This brings all the pressure of the stock on the cambium layers, thereby uniting the two cambium layers more firmly. This latter fact is of considerable importance.

Whip-grafting. This is the best method of grafting the persimmon in Florida if the stock is small. For the best results the stock should not be over one-half inch in diameter; but stocks one-inch in diameter can be successfully grafted by this method, although the operation is more difficult. By this method a greater area of the cambium layers of the stock and scion are brought in contact. Then, too, the stock and scion can be held together more securely. As the method is here illustrated, it will need but little explanation.

Just at the surface of the ground a diagonal cut one or two inches long is made on the stock. Then the stock is split vertically for a short distance. A diagonal cut is then made at the lower end of the scion. This cut surface of the scion is split similar to the

PLATE I.



Persimmon Propagation.

Scion and stock cut, ready for placing together. Scion and stock placed together, ready for wrapping.

stock. The two are then put together, the tongue of the scion being inserted into the cleft of the stock. The cambium layers of the two must be in close contact. The union is then tightly wrapped with waxed cloth. If there are crevices, they must be filled with grafting wax. As soon as the stock and scion are well united, the waxed cloth should be removed. This last operation is very essential and should always be promptly attended to.

The best time to graft is when stock and scion are in a dormant condition. Winter or early spring just before growth starts is the best time to graft. This will give the best conditions for a rapid union of stock and scion.

Budding—Budding is more easily performed than grafting. Although it is the leading method of propagating citrus trees in Florida it is not successful with the persimmon, and should not be employed.

Cultural.

Area of Cultivation. The Japanese persimmon is now widely cultivated to a greater or less extent throughout most of the Southern United States and in parts of California. In the Southern States the area adapted to its culture corresponds in a certain measure with the cotton belt. It cannot be grown successfully north of Washington, although it has been fruited in New Jersey, and the northern limit of profitable culture is considerably south of the District of Columbia. The leading states are California, Tennessee and the Gulf States. In Texas there are several large orchards, but so far as known to the writers, the largest single orchard in the country is that owned by Mr. William Macklin of Dinsmore, Fla., who has between two and three thousand trees. Florida probably has the largest acreage of any state in the Union but the total

acreage has not yet been definitely ascertained. The conditions for the culture of the Japanese persimmon in Florida are ideal, no other state having soil and climatic conditions more suitable. It can be grown from the extreme west to the extreme east and from the Georgia boundary to the southern portion of the state.

Persimmon plantings have so increased in both California and Florida, that the nursery supply of desirable varieties has been entirely exhausted during the last two seasons.

Soils. In our State the Japanese persimmon is propagated entirely upon native stocks. The native persimmon has a wide range of soil adaptibility and specimens of it may be found growing in the hammocks, on the high pine lands, or flat woods. Broadly speaking, however, the best soil for the Japanese persimmon is one of rather open texture containing a fair amount of humus and having good drainage. Regarding the soil conditions in Japan, the Japan Agricultural Society makes this statement: "The soil most adapted to the plantation of the Kaki is the gravelly clay loam. In a situation neither too dry nor too damp; a free open space is necessary."

Preparation of the Soil. The soil should be thoroughly cleared of all stumps, roots and trees, and put in a thorough state of tillage before setting out the trees. They may be set in old fields with good success, provided they are given plenty of plant food. In fact, the native persimmon in our State may be regarded as an "old field tree." If the soil is poor, however, something should be done toward building it up before the trees are set. A crop of beggarweed, velvet beans or cow peas should be grown, if possible, the year previous and turned into the soil.

Distances. The Japan persimmon may be divided into two groups, based upon the habit of the growth of the trees. Some

varieties, *Costata* for instance, are strict and upright in habit, and consequently require less space than varieties of more or less spreading habit like *Triumph* and *Hachiya*. However, this difference in habit of growth need hardly be taken into consideration in discussing the question of distances. As a general thing, 15 to 20 feet distance will be about right.

Time of Planting. The best time to set Japanese persimmon trees is during the months of December and January. Preferably, they should be planted as early in the season as possible so as to allow them to become well settled in the ground that they may take advantage of the first opportunity to commence growth in spring.

Setting the Trees. As a general rule, the roots of nursery-grown Japanese persimmons are not good, when compared with the root systems of other trees in this State. There is no question but that the root system would be improved if the seedling stocks were transplanted from the seed bed to the nursery rows before they are grafted. This would have a tendency to increase the number of fibrous roots and the chances of success in transplanting would be much improved. As a general thing, the native persimmon root is far from being an ideal root system. The lateral roots are usually few in number and quite large. The greatest care should be exercised in transplanting trees. The roots should not be allowed to dry out in the least and a goodly application of water should be given at the time of setting.

Fertilizing. The Japanese persimmon in common with all other fruits is benefited in our State by applications of fertilizers. Still, in many cases it does not seem to need the same quantities as are required by most other fruit trees.

As a result of experimental work at the Station, we have de-

cided that a fertilizer analysing 3 per cent. nitrogen, 6 per cent. phosphoric acid and 10 per cent. potash, applied at the rate of five pounds per tree for six year old trees is about right.

It does not appear that the Japanese persimmon tree is in any wise particular about the source of its food supply, in which respect it distinctly differs from citrus fruits.

Experiments carried out on the station grounds to determine the relation between the amount of potash in the fertilizer and the dropping of the fruit during the early summer months gave negative results. Even when the potash content of the fertilizer was doubled, the fruit did not hold any better than with a normal amount. It appears that the dropping of the fruit may be due in some cases to self-sterility, but on the other hand it is a noteworthy fact that generally as the trees become older and increase in size, the young fruits do not drop to such an extent.

All the nitrogen required by the trees may be supplied by growing beggarweed as a cover crop and this plan is recommended wherever possible.

Cultivation. The cultivation of the persimmon plantation should be much the same as that given citrus groves. On high, dry soils, the ground should be cultivated frequently during the spring months and should be discontinued after the rainy season begins. Moist soils should be given little or no cultivation, but the cover crop of weeds and beggarweed should be cut once or twice during the season.

Pruning. While as a general rule the persimmon will do with but little pruning, some varieties should be pruned to some extent. Strict upright varieties, like *Costata*, should be headed back. On the other hand those with thick bushy tops like *Triumph* and *Hachiya* should be thinned out. All dead and injured branches

should be removed and at the time of planting the young trees should be cut back to within two or two and one-half feet of the ground.

Marketing.

Picking. The fruit should be gathered when it is fully matured and before it softens, if it is intended for long distance shipments. It must be carefully handled so that the rind is not injured and it should not be poured from one receptacle to another, but handled entirely with the hands. It must be cut from the trees, and for this purpose the best instrument is a pair of ordinary orange clippers of the Weiss pattern. All injured or bruised specimens should be discarded.

If the fruit is to be delivered to the home market it is preferable that it be allowed to become quite or nearly matured on the trees. In Florida difficulty is usually encountered in allowing it to ripen on the trees as the mocking birds are extremely fond of the fruit. In view of this fact, the better plan is to remove the fruit from the trees when fully matured and just before it begins to soften. Place it in a dry, warm room and allow it to ripen. The flavor will be quite as good as when ripened on the trees.

Packing. The fruit may be packed immediately after removal from the trees. It should be sized and graded. Two grades will be sufficient and extremely small fruit should not be packed. The best package for shipping the Kaki is the six basket carrier, commonly used throughout the State for tomatoes and peaches. The fruit should be wrapped, the wrapper being of the best quality, as it is likely to be torn by the small, sharp, nipple-like point at the apex of the fruit. In placing them in the baskets they must be put in in regular order and each basket in the carrier should contain

PLATE II.



Fig. A. A basket of Tsuru Persimmons.



Fig. B. Packed crate of Tsuru Persimmons.

exactly the same number of fruits. The first row should be put in with the base downward and if three layers are required to fill the basket, the second one should be reversed, while the third layer should be placed with apices upperward. The fruit should project about one-half inch above the sides of the baskets. If the fruit is to be sent into a new market, it will be a good idea to place in each basket a small placard giving the name of the fruit and stating how and at what stage of ripeness it should be eaten. This will in some measure prevent attempts at eating it before it is fully ripe and hence create a more favorable impression of the fruit.

Some of the California shipments of Japanese persimmons to the Eastern markets have been made in box carriers containing a number of trays in which the fruit is placed in single layers. This seems to be an excellent method for shipping them and when opened on the market, they show up in inviting shape.

From time to time complaints have been made that the Japanese persimmon did not carry well when shipped to Northern markets. Believing that this undesirable condition arose from shipping the fruit when too ripe, three or four shipments were made from the Department of Horticulture last autumn to determine the carrying quality of the fruit when picked at the right time and put up in good shape. One crate was shipped to Prof. F. W. Rane, Durham, N. H., and was received on Oct. 15. Prof. Rane replied as follows:

One box Costata Persimmons—1 fruit over-ripe, 1 fruit soft, 14 hard.

One box Costata Persimmons—1 fruit over-ripe, 2 fruits soft, 12 fruits hard.

One box Tsuru Persimmons—5 fruits over-ripe, 2 soft, 16 fruits hard.

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One box Zengi Persimmons—1 fruit over-ripe, 8 fruits ripe, 25 fruits hard.

One box Triumph Persimmons—5 fruits ripe, 16 fruits hard.

I do not understand why more of these are not sent to our Northern markets; at least, they seem to come through in good shape."

A second crate was sent to Prof. A. T. Erwin, Ames, Iowa, who reported as follows:

"I am pleased to acknowledge receipt of your recent favor and also the crate of persimmons which came to hand in nice shape * *. As to condition upon arrival I am pleased to report as follows: Tsuru. Twenty specimens per basket and three baskets. These were all firm and in good condition and still unripe and astringent ten days after arrival.

Costata. Ten fruits, one-half basket. Nearly ripe one week after arrival, quality good and all of them were in firm condition.

Triumph. Twenty-five fruits per basket and two and one-half baskets. Ripe one week after arrival. All the fruits of this variety opened up in good shape, with the exception of one which was slightly bruised and soft. In fact, the whole shipment came through in the best of condition and opened up in nice shape."

Small shipments were also made to Prof. F. A. Waugh, Amherst, Mass., and to Prof. U. P. Hedrick, Agricultural College, Mich, and these went through in good shape.

In regard to his experiences in marketing a small lot of Kaki of the Triumph variety, Mr. Walter Cooper, Sorrento, Fla., under date of Dec. 18, 1903, wrote the Department as follows:

"I have not many varieties of persimmons in cultivation, and not many large trees. In fact, while I have possibly 100 small, one and two year grafts of Triumph now in cultivation, I have but

one large tree of this variety. This is a beauty and of handsome shape. For the season of 1901 it gave me thirteen packed crates, three pecks to the crate, and in 1902 it gave eighteen packed crates. The cold spell of February 15th, or thereabout, last spring injured the coming crop to the extent that I had only about two crates on this same tree. Season of 1901 Triumph sold at \$3.00 per crate for the entire crop in Philadelphia. Season of 1902 prices were \$2.00 to \$2.25 per crate."

Uses. In Japan where the persimmon has been in cultivation for centuries a number of different ways of preserving and preparing the fruit for consumption are in common use. The following letter from Prof. Kizo Taniari of the Agricultural College, Imperial University, Tokio, Japan, gives the different methods in use in that country:

"I duly received your favor and am glad to reply to your inquiries on the Japan persimmon, Kaki. I presume you know that there are two distinct varieties of Kaki, the sweet one and the austere varieties. The sweet varieties are readily eaten and I think what you want to know is how to cure the austere varieties, hence, I will tell you how to treat the austere varieties so as to make them edible or change them into sweet ones in the following ways:

First Method—When fairly ripened pick the fruit from the trees, peel off the skin and hang them by threads attached to the stems in a room for two or three weeks. They will then turn brown or black and become soft. You will say they are the most delicious fruits in the world and dried still further, they will become just like dried figs, or better than figs. Further, pack them in a box in alternate layers with cut rice straw and keep them for a month. Black ones then become covered with a white powder (not mouldy.) They then become very sweet, though the sweetness may

not be retained through the next summer.

Second method—Harvesting time being the same as above, the fruits are packed into an empty wine cask, (in Japan Sake casks, Japanese rice wine). This should still be full of alcoholic flavor, or if the flavor be weak, the cask should be sprinkled with wine or brandy or any other spirit. Sherry wine somewhat resembles our Sake. Sprinkle the fruits very slightly with wine and keep covered air tight for a week or two according to the temperature and the degree of austereness of the fruit. At the end of the time they become sweet.

Other Methods: The process of sweetening is not merely limited to the above methods, but the fruit may be treated in several other ways; for instance, put new rice straws and dried haulms of sweet potato in about equal proportions in a vat, filling it about one-fifth full. To this add a little wood ashes and pour warm water over them. Stir up the straw so as to get it thoroughly wet. When the water is tepid, put in fruit to fill it one-quarter to one-third full and stir up to wet the fruit and imbed it in the straw. Cover the vat for five or seven days, after which time the fruit will be fit to eat. The fruits thus cured, are not as sweet as those cured by the Sake cask process."

These methods of preparing the fruit are applied only to the astringent or light-fleshed varieties and not to the dark-fleshed which really never become astringent.

In this country the Japan persimmon is valued chiefly as a dessert fruit, eaten raw. When fully matured, the flesh becomes jelly-like and may be readily scooped out with a spoon. Some prefer to add cream, while others eat the fruit without it. It may be used in making marmalades and puddings, and perhaps in other ways.

In Japan a valuable juice is expressed from the green fruit and used as a varnish. It is known as "Kakishibu."

Some idea of the food value of the Japanese persimmon may be obtained from the following analyses by J. B. McBryde, chemist of the Tennessee Experiment Station, published in Bulletin 1, vol. xl, of that station. The specimens of fruit from which these analyses were made were obtained from Florida and Georgia.

	Average weight of fruit in grams.		Sugar.		Total acid in pulp.	Proximate analysis of Pulp.			
	Per cent of seed in fruit.		In pulp.	In fruit.		Water.	Crude Protein.	Fats and Carbohydrates.	Crude ash.
No. 1. Hachiya	180	Seed-	16.83	16.83	.1	71.77	0.93	28.42	0.88
No. 2. Tsuru	194	less	15.67	15.67	.1	73.46	0.74	26.16	0.64
No. 3. Hiyakume	175	1.71	17.33	17.52	.1	70.17	1.10	27.58	1.15
No. 4. Yemon	160	Seed-	15.99	15.99	.1	76.26	0.45	22.69	0.65
		less							

	Sugar.		Total acid.	Proximate analysis.			
	In pulp.	In fruit.		Water.	Crude protein.	Fats and carbohydrates.	Crude ash.
Persimmons, eight analyses	18.57	16.98	0.15	68.49	0.67	29.95	0.89

As pointed out by Professor McBryde, the persimmon is richer in sugar than either apples, cherries, strawberries or oranges, while Prof. G. E. Colby found the California samples to contain nearly as much sugar as the French prune and the white Adriatic fig, and 2 per cent less sugar than the average California grape.

PERSIMMON INSECTS.

H. A. Gossard.

White Peach Scale, *Diaspis pentagona*. This insect is a dangerous enemy to the persimmon and attacks the Japanese varieties as well as the natives. Fortunately, it is not widely distributed in Florida, but is known to occur in Escambia and Duval Counties and is reported to occur in another county. The latter report lacks confirmation, but is probably correct. A description and the life history of the insect is given in bulletin No. 61 of this station.

The most satisfactory remedy is probably found in lime-salt-sulphur wash. One application should be made when the trees are thoroughly dormant, about the last of December, and a second application just before growth starts in the Spring, about the middle or latter part of February.

San Jose Scale, *Aspidiotus perniciosus*.—This pest does not often attack the Japanese varieties seriously, but occasionally becomes bad on the native persimmon. The remedy is the same as for the preceding.

The Twig Girdler, *Oncideres cingulatus*.—The twig girdler's work is well known on various hard wood trees, such as hickory, pecan and oak, and it has the reputation of being partial to the persimmon, though I have not observed the insect to be worse on it, or as bad, as upon the trees mentioned. The eggs are thrust beneath the bark, after which the female makes a straight, smooth cut around the limb, either completing the work or so nearly severing the twig that the first strong wind carries it to the ground. The twig absorbs enough moisture from the earth to enable the

young sawyer to develop and the following summer it leaves the wood, going into the ground to pupate. It issues as an adult in late summer, usually in September.

Remedy. Pick up all twigs cut by the girdler and burn during fall and winter.

The Orange White Fly, *Aleyrodes citri*.—This insect is found sparsely on Japan persimmons when planted near infested orange groves or other plants which support it in numbers. It does not seem to perceptibly damage the persimmon, and is mentioned chiefly for the purpose of warning orchardists that the white fly may be introduced into new localities upon this plant.

Miscellaneous.—Wasps, bees and flies frequent the fruit when ripe, especially after it has been pecked by birds or after the skin has been split through any cause.

INDEX OF AMERICAN LITERATURE ON THE PERSIMMON.

As already noted, the Japanese persimmon literature in America is quite scant and scattered. The references given below embrace practically all of importance that has been published in America by the Experiment Stations, United States Department of Agriculture, in Horticultural Works, and the reports of horticultural societies. References to the literature of the native persimmon, *Diospyrus Virginiana*, are also given.

Bailey, L. H. The Persimmon, in the Evolution of our Native Fruits. New York. The Macmillan Co., Copyrighted. 1898. Pp. 433-441.

—Kaki, or Japanese Persimmon, in Annals of Horticulture. New York. Orange Judd Company. Copyrighted 1894. Pp. 92 and 126. 1894.

- Barber, C. E. Kaki, or Persimmon, in Proc. Sixteenth Annl. Meet. Fla. State Hort. Soc. DeLand, Fla.: E. O. Painter & Co. 1893. Pp. 57. 1893.
- Bartram, Isaac. A Memoir on the Distillation of Persimmon. In Trans. Amer. Phil. So. 1, 301. 1889.
- Berckmans, P. J. The Japanese Persimmon, in Cyclopædia of American Horticulture, by L. H. Bailey. New York: The Macmillan Co. Copyrighted 1901. Pp. 1281-1282. 1902.
- Bielby, C. S. The Kaki, in Proc. Seventh Annl. Meet. Fla. State Hort. Soc. DeLand, Fla.: E. O. Painter & Co. 1894. Pp. 40 and 44.
- Colby, George E. Partial Analysis of Seedless Persimmon, in Report of Work of Agricultural Experimental Station, University of California. 1894-95. Sacramento: A. J. Johnston. Pp. 183. 1896.
- Emerson, Gouverneur. Persimmon (*Diospyrus Virginiana*), in The American Farmers' Encyclopædia. New York: A. O. Moore. Copyrighted 1857. Pp. 889. 1858.
- Griffing, W. D. Kaki, in Proc. Fourteenth Annual Meet. Fla. State Hort. Soc. DeLand, Fla.: E. O. Painter & Co. 1901. Pp. 84. 1901.
- Hadley, C. F. See Troop J., and Hadley, O. M.
- Harcourt, Helen. Japanese Persimmon, in Florida Fruits and How to Raise Them. Louisville, Ky.: Jno. P. Morton & Co. Copyrighted 1886. Pp. 284-286. 1886.
- Hart, E. H. The Persimmon, in the American Fruit Culturist, 20th edition, by Jno. J. Thomas. New York: Wm. Wood & Co. Copyrighted 1897. Pp. 605-613. 1897.
- The Persimmon, in The American Fruit Culturist, 21st edition, by John J. Thomas. Revised and enlarged by William

- H. S. Wood. New York: William Wood & Co. Copyrighted 1903. Pp. 669-677 and 782. 1903.
- Hart, W. S. Kaki, in Proc. Thirteenth Annual Meet. Florida State Horticultural Society. DeLand, Fla.: E. O. Painter & Co. 1900. Pp. 103. 1900.
- Henderson, Peter. Date Plum, Persimmon, in Henderson's Handbook of Plants and General Horticulture. New York. Peter Henderson & Co. Copyrighted 1889. Pp. 128-129. 1890.
- Keck, Irving. Kaki, in Proc. Sixteenth Annual Meet. Florida State Hort. Soc. DeLand, Fla.: E. O. Painter & Co. 1903. Pp. 58. 1903.
- Lipsev, L. W. The Kaki, in Proc. Sixth Annual Meet. Fla. State Hort. Soc. DeLand, Fla.: E. O. Painter & Co. 1893. Pp. 37-40. 1893.
- Livingstone, B. F. The Kaki, in Proc. Sixteenth Annual Meet. Fla. State Hort. Soc. DeLand, Fla.: E. O. Painter & Co. 1903. Pp. 162. 1903.
- Loring, Geo. B. The Japan Persimmon, in Report of the United States Department of Agriculture, Washington, D. C. 1883. Pp. 4. 1884.
- Japan Persimmon, in Report of the United States Department of Agriculture, Washington, D. C. 1883. Pp. 7. 1884.
- McBryde, J. B. Notes on the Chemistry of the Persimmon, in Bulletin No. 1, Vol. XI. Knoxville, Tenn. University Press. 1899. Pp. 220-223. 1899.
- Palmer, E. The Persimmon, in United States Department of Agriculture. Washington, D. C. 1870. Pp. 417. 1871.
- Powers, S. Kaki—Japanese Persimmon, in Proc. Thirteenth Annual Meet. State Hort. Soc., Catalogue of Fruits. DeLand, Fla.: E. O. Painter & Co. 1900. Pp. xiv. 1900.

- Ragan, W. H. *Kakis, Japanese Persimmons*, in *Revised Catalogue of Fruits*, Bulletin No. 8, Division of Pomology, U. S. Department of Agriculture, Washington, D. C.: Government Printing Press. 1899. Pp. 54. 1899.
- Reasoner, P. W. *Kaki, or Japan Persimmon*, in *The Condition of Tropical and Semi-Tropical Fruits in the U. S. in 1887*. Washington: Government Printing Office. 1891. Pp. 108-109. 1891.
- Report of United States Department of Agriculture. 1870. *Persimmon in Mississippi Valley*. Pp. 417.
- Saunders, William. *Japan Persimmons*, in Report of the United States Department of Agriculture. Washington, D. C. 1876. Pp. 68. 1877.
- Japan Persimmon, in Report of the United States Department of Agriculture. Washington, D. C. 1878. Pp. 195. 1879.
- The Japan Persimmon, in Report of the United States Department of Agriculture. Washington, D. C. 1886. Pp. 692-693. 1887.
- Japan Persimmons, in Report of the United States Department of Agriculture. Washington, D. C. 1889. Pp. 121. 1890.
- Japan Persimmons, in Yearbook of the United States Department of Agriculture, Washington, D. C. 1897. Pp. 187. 1898.
- Stewart, A. W. *The Persimmon*, in *Proc. Eighth Annual Meet. Fla. State Hort. Soc. DeLand, Fla.*: E. O. Painter & Co. 1895. Pp. 78. 1895.
- Taber, G. L. *Another Estimate of the Japanese Persimmons*, in *Cyclopedia of American Horticulture*, by L. H. Bailey. New

- York: The Macmillan Co. Copyrighted 1901. Pp. 1282-1283. 1902.
- Tamari, Kizo. The Japanese Persimmon, in Rep. Mich. Hort. Soc. Lansing, Mich. Thorp & Godfrey. 1886. Pp. 90-91. 1886.
- Troop, J. and Hadley, O. M. The American Persimmon, in Bulletin No. 60, Vol. VII, Ind. Exp. Sta. Lafayette, Ind. 1886. Pp. 41-45. 1887.
- Troop, J. The Native Persimmon, in Cyclopedia of American Horticulture, by L. H. Bailey, New York: The Macmillan Co. Copyrighted 1901. Pp. 1281. 1902.
- Van Deman, H. E. The Japan Persimmon, in Report of the United States Department of Agriculture. Washington, D. C. 1886. Pp. 261. 1887.
- The Kaki (or Japanese Persimmon), in Report of the United States Department of Agriculture. Washington, D. C. 1887. Pp. 642-645. 1888.
- The Kaki, in Report of the United States Department of Agriculture, Washington, D. C. 1889. Pp. 449-450. 1890.
- The Kaki, in Report of the United States Department of Agriculture, Washington, D. C. 1890. Pp. 422-423. 1891.
- Special Investigation of the Kaki in Georgia and Florida, in Report of the United States Department of Agriculture, Washington, D. C. 1891. Pp. 385-389. 1892.
- Kaki, in Report of the United States Department of Agriculture. Washington, D. C. 1892. Pp. 259 and 266. 1893.
- Watts, R. L. Persimmons, American and Japanese, in Tenn. Exp. Station Bul. No. 1, Vol. XI, Knoxville, Tenn., University Press. 1899. Pp. 191-219. 1899.
- Waugh, F. A. The Persimmon, in Systematic Pomology. New

York. Orange Judd Co. Copyrighted 1903. Pp. 205-206. 1903.

Whitner, J. N. Japan Persimmon, or Date Plum, in Gardening in Florida. Second edition. Jacksonville, Fla.: C. W. Da-Costa. Pp. 207-210. 1885.

Wickson, E. J. The Persimmon, in California Fruits. Third edition. San Francisco, Cal.: Pacific Rural Press. Copyrighted 1899. Pp. 384-385. 1900.

Woodworth, N. The Kaki, in Proc. Sixth Annual Meet. Fla. State Hort. Soc. DeLand, Fla.: E. O. Painter & Co. 1893. Pp. 52-54. 1893.

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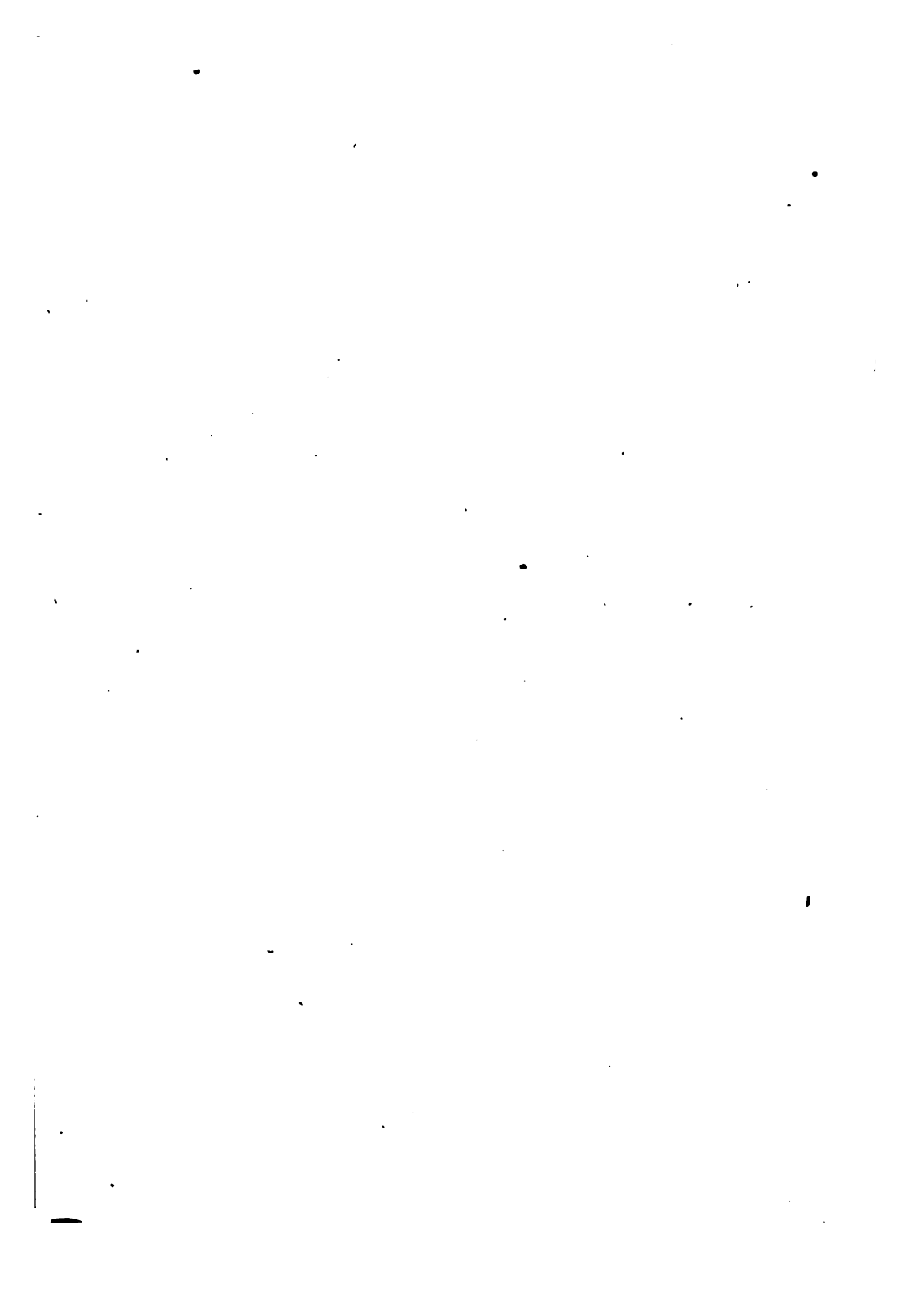
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BULLETIN NO. 72

JUNE, 1904.

FLORIDA
AGRICULTURAL EXPERIMENT STATION

Feeding Horses and Mules
on
Home-Grown Feed-Stuffs.

By CHAS. M. CONNER.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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Feeding Horses and Mules on Home-Grown Feed-Stuffs.

BY CHAS. M. CONNER

The object of the experiment herein described was to determine whether or not home-grown feed-stuffs could be substituted for corn and oats, which are high priced. The all-important question to the feeder of live stock is, "How may I reduce the cost of feeding my animals?" Since Florida does not, as yet, raise enough corn to supply home consumption, the deficiency must be supplied by shipping corn from the corn belt. This, of necessity makes the price of corn high.

Corn is the principal grain used in the State for feeding horses and mules, and, frequently the corn that is shipped in from the West is of a very low grade, and is more or less injurious to the health of the animals. Corn is what is known as a carbonaceous feed and its principal use is to supply heat and energy to the animal; in other words it enables the animal to do work. The animal also requires a certain amount of protein, or blood-building and muscle-forming feed. This may be supplied to a certain extent by corn but only slightly, as will be noticed on looking up the analysis of corn. Beggarweed hay was used to supply protein.

The high price of corn led us to investigate the feeding value of sweet potatoes and cassava as a substitute for corn.

Sweet potatoes have been used, more or less, by the farmers of the South as a food for their work stock, but no data have been collected on the subject. So far as we can learn, this crop has been used to feed animals having only light work to do or none

at all. In the experiment herein detailed we used sweet potatoes to feed animals that were doing rather hard farm work.

Cassava has been used more or less, but like the sweet potato, no data were available.

Both of the above plants have been used extensively for feeding cattle; but, in feeding horses, the fact that these crops have high water contents, must be taken into consideration. The stomach of the horse will hold about 20 quarts while that of the cow will hold about 270 quarts; thus you see that it would be a physical impossibility for a horse at hard work to eat enough of a bulky or watery food to supply his system with enough digestible matter, while the cow will do well on it.

In making up the rations for the teams the bulkiness of the feed was taken into consideration.

The station has at its disposal eight head of horses and mules. These were divided into two lots; one animal in each team being in lot I, and the other in lot II. The division was made in this way in order that both should do the same amount of work and receive the same attention, as grooming, watering, etc.

The animals were watered after feeding in the morning, and at noon before and after feeding, and before feeding at night, as is the practice on all farms. No record was kept of the amount of water drunk, from the fact that the experiment was to run so long and the amount of water consumed was not deemed of much importance.

The hay used in this experiment was what would be called A1 beggarweed. This was not all pure beggarweed for the reason that in some parts of the field the beggarweed did not grow thick enough to keep down the sand-spur; hence some of this grass was mixed with the hay, as will be found in most cases where hay of this character is saved on the farm. As yet we have no digestion

coefficient for this plant hence we made up our rations on the supposition that this hay had about the same feeding value as good cow-pea hay. The hay was run through the shredder to facilitate weighing, etc. The roots were run through a cutting box, or cut by hand before feeding; this was found necessary because of the large size of most of the roots.

The rations were weighed up each day as per schedule given below. The refuse was weighed back each day and the animal charged with just what it ate.

The animals were weighed three times the first week and the average taken as the initial weight. They were weighed once every week thereafter until the last week when they were weighed three times again and the average taken as the final weight. Weighing was done before watering in the morning.

The following is a description of the animals used:

Team No. I, Charley and George, was of medium weight, draft horses, about nine years old, used for plowing and hauling throughout the greater part of the experiment.

Team No. II, Peter and Kit, was of medium-weight, mules, about eight years old, used for plowing and hauling.

Team No. III, Logan and Joe, was rather light, mules, about five years old, used for plowing and hauling.

Team No. IV, Maude and Fanny, was rather light, about six years old, did no regular work, but since each did the same amount the rations are comparative.

The names will designate sex.

In calculating the price of rations we used what we considered the normal market price. All the feed was raised on the College Farm.

Estimated price of feed:

Corn\$22.50 per ton. Sweet Potatoes, \$6.00 per ton.
 Hay 15.00 per ton. Cassava 6.00 per ton.

Rations offered:

Charley, initial weight, 1,193 lbs.

Corn 7 lbs.)
 * Hay15 lbs.) Cost per day 23.62c.
 Sweet potatoes15 lbs.)

George, initial weight, 1,096 lbs.

Corn12 lbs.)
 Hay18 lbs.) Cost per day 27c.

Peter, initial weight, 1,071 lbs.

Corn 6 lbs.)
 Hay17 lbs.) Cost per day 24c.
 Sweet potatoes15 lbs.)

Kit, initial weight, 932 lbs.

Corn10 lbs.)
 Hay15 lbs.) Cost per day 22.50c.

Logan, initial weight, 921 lbs.

Corn 5 lbs.)
 Hay17 lbs.) Cost per day 22.87c.
 Sweet potatoes15 lbs.)

Joe, initial weight, 945 lbs.

Corn10 lbs.)
 Hay15 lbs.) Cost per day 22.5c.

Maude, initial weight, 996 lbs.

Corn 3.5 lbs.)
 Hay15 lbs.) Cost per day 18.79c.
 Sweet potatoes12 lbs.)

Fanny, initial weight, 911 lbs.

Corn 7 lbs.)
 Hay15 lbs.) Cost per day 19.12c.

The above rations were made up after a two weeks preliminary

*The Hay was increased to 20 lbs. in second half of period.

period in which we tried to determine the capacity of each animal. We did not use the feeding standard, but rather allowed the capacity of the animal to influence the make-up of the ration. However, if the analysis of beggarweed hay is taken as equal to that of cow-pea, we find that the rations are about up to the standard for horses hard at work, which is as follows: "Standard for a 1,000-lb. horse at hard work calls for 2.5 lbs. of protein, 13.3 lbs. of carbohydrates and .8 lb. of ether extract."

The ration furnished Charley during the first half of period contained 2.3 lbs of protein, 14.9 lbs. of carbohydrates and .69 lb. of ether extract. On examining the table of feed given below, we find that this ration was larger than he could consume.

In feeding horses and mules we do not seek to make the animal gain in weight as we would a steer, but rather to keep him from losing weight while at hard work. If we succeed in doing this the ration is sufficient. The weight of a horse or mule in good condition should be fairly constant; but, if the animal falls off in weight, either it is doing more work than it can stand, or the ration fed is not sufficient to maintain it—that is barring sickness. An increase or decrease of a few pounds in the weight of an animal does not signify anything as this gain or loss may be due to the amount of water drunk by the animal the day before. On a warm day an average mule or horse will drink from 50 to 110 lbs. of water.

All animals were in good condition at the beginning of this experiment.

The following table shows the weight of animal and amount of feed consumed per week. It will be noticed that at the end of the sixth week the rations were changed, that is, the animal getting all corn ration gets sweet potatoes and corn. This change was made gradually; one week being used in making the change.

TABLE 1.

DATE	CHARLEY			GEORGE			PETER			KIT			LOGAN			JOE			MAUDE			FANNY						
	Feed Consumed, Lbs.		Weight	Feed Consumed, Lbs.		Weight	Feed Consumed, Lbs.		Weight	Feed Consumed, Lbs.		Weight	Feed Consumed, Lbs.		Weight	Feed Consumed, Lbs.		Weight	Feed Consumed, Lbs.		Weight							
	Corn	Hay		Corn	Hay		Corn	Hay		Corn	Hay		Corn	Hay		Corn	Hay		Corn	Hay		Corn	Hay					
Oct. 24-30	49	85	105	1182	84	98	1095	42	68	105	1071	70	54	35	50	105	921	70	70	945	24.5	91	84	995	49	76	911	
Oct. 31	49	107	105	1237	84	71	1087	42	65	105	1076	70	51	35	55	90	921	70	67	959	24.5	99	84	1007	49	84	925	
Nov. 6	49	92	15	1234	84	73	1099	42	70	105	1064	65	41	35	65	96	928	70	88	972	24.5	88	84	1009	49	90	944	
7-13	49	100	105	1240	84	81	1094	42	87	105	1084	65	48	35	48	115	986	70	92	965	24.5	96	84	1026	49	78	954	
14-20	49	99	105	1245	84	80	1108	42	67	105	1088	64	51	35	59	105	914	68	78	970	24.5	91	84	1020	49	88	960	
21-27	49	97	105	1262	84	76	1100	42	86	105	1102	56	54	35	64	105	968	69	79	988	24.5	104	84	1028	49	101	955	
Nov. 28	49	97	105	1262	84	76	1100	42	86	105	1102	56	54	35	64	105	968	69	79	988	24.5	104	84	1028	49	101	955	
Dec. 4	49	97	105	1262	84	76	1100	42	86	105	1102	56	54	35	64	105	968	69	79	988	24.5	104	84	1028	49	101	955	
Total,	504	590	680	504	479	680	252	443	63	390	239	322	35	57	101	930	68	67	965	24	593	84	1015	49	86	940		
Aver.	49	98	105	1234	84	79	1089	42	73	105	1081	63	49	35	57	101	930	68	67	965	24	593	84	1015	49	86	940	
Dec. 12-18	84	110	1240	49	104	105	1114	84	82	1068	35	47	90	35	69	105	938	35	79	105	974	49	89	1016	24.5	77	900	
19-25	84	116	1240	49	105	105	1120	84	67	1082	32	36	88	35	70	93	944	35	71	105	984	49	114	1012	24.5	91	900	
Dec. 26	84	122	1242	49	89	105	1106	84	64	1080	31	67	80	35	70	70	946	35	82	105	985	49	127	1023	24.5	97	905	
Jan. 1	84	126	1250	49	81	105	1100	84	74	1088	27	47	73	35	70	67	940	35	82	105	990	49	131	1023	24.5	81	904	
2-8	84	126	1250	49	81	105	1100	84	74	1088	27	47	73	35	70	67	940	35	82	105	990	49	131	1023	24.5	81	904	
9-15	84	126	1250	49	81	105	1100	84	74	1088	27	47	73	35	70	67	940	35	82	105	990	49	131	1023	24.5	81	904	
16-22	84	105	1186	49	90	110	110	84	72	1068	33	43	81	34	70	76	928	35	68	105	994	49	133	1036	24.5	93	900	
Total,	504	686	686	504	563	63	504	435	1078	122	273	503	430	447	210	456	63	294	723	147	131	504	147	131	504	147	131	504
Aver.	84	114	1230	49	98	105	1108	84	72	1078	63	49	81	34	70	76	942	35	76	105	974	49	121	1027	24	88	902	

A careful survey of the table will show us that in every case but one, that of George, the actual ration consumed by the animal cost less per day when sweet potatoes were used than when an all corn ration was used as noted below.

Charley consumed per day, during first half of period:

Corn	7 lbs.)	
Sweet potatoes	15 lbs.)	Cost, 22 87c.
Hay	14 lbs.)	

Second half—

Corn	12 lbs.)	
Hay	16.3 lbs.)	Cost, 25.72c.

George consumed per day during first half of period:

Corn	12 lbs.)	
Hay	11.4 lbs.)	Cost, 22.05c.

Second half—

Corn	7 lbs.)	
Sweet potatoes	15 lbs.)	Cost, 22 42c.
Hay	13.4 lbs.)	

Peter consumed per day during first half of period:

Corn	6 lbs.)	
Sweet potatoes	15 lbs.)	Cost, 19.12c.
Hay	10.5 lbs.)	

Second half—

Corn	12 lbs.)	
Hay	10.3 lbs.)	Cost, 21.22c.

Kit consumed per day during first half of period:

Corn	9.3 lbs.)	
Hay	7.1 lbs.)	Cost, 15.78c.

Second half—

Corn	4.6 lbs.)	
Sweet potatoes	11.9 lbs.)	Cost, 13.60c.
Hay	6.5 lbs.)	

Logan consumed per day during first half of period:

Corn 5 lbs.)
Sweet potatoes14.4 lbs.) Cost, 15.94c.
Hay 8 lbs.)

Second half—

Corn10 lbs.)
Hay10.6 lbs.) Cost, 19.20c.

Joe consumed per day during first half of period:

Corn 9.8 lbs.)
Hay11.3 lbs.) Cost, 19 5c.

Second half—

Corn 5 lbs.)
Sweet potatoes15 lbs.) Cost, 18.37c.
Hay11 lbs.)

Maude consumed per day during first half of period:

Corn 3.5 lbs.)
Sweet potatoes12.0 lbs.) Cost, 17.66c.
Hay13.5 lbs.)

Second half—

Corn 7 lbs.)
Hay17.3 lbs.) Cost, 20.85c.

Fanny consumed per day during first half of period:

Corn 7 lbs.)
Hay12.3 lbs.) Cost, 17.10c.

Second half—

Corn 3.5 lbs.)
Sweet potatoes12.0 lbs.) Cost, 16.94c.
Hay12.4 lbs.)

The amount of hay offered in all the ration was greater than the needs of the animal, which accounts for the difference, in most cases, of the cost of the ration offered and the cost of ration consumed.

In looking over the weights of the animals, we see very little variation. In all but two cases, there was an increase in weight when sweet potatoes were fed.

The most important fact brought out in this experiment is that sweet potatoes may be substituted for at least one-half of the corn ration, this substitution being at the rate of three pounds of sweet potatoes for one of corn. This being the case, an acre of sweet potatoes yielding 150 bushels is equal to a yield of 50 bushels of corn, so far as feeding the work stock is concerned. We do not think that a horse at hard work would do well on an all sweet potato ration from the fact that the bulk would be too great for the capacity of the stomach. We expect to take this phase of the question up later on and determine just how far this substitution can take place. We have fed one mule for three months on sweet potatoes, cassava and hay with good results. He was used for light work about the lot, such as hauling feed, bedding, etc.

At the end of the sweet potato period cassava was substituted for sweet potatoes, and the feeding continued for six weeks longer. Two of the teams were dropped, as the amount of cassava was limited. We have no digestion coefficient for cassava, hence we assumed that it had about the same feeding value as sweet potatoes and fed accordingly. We soon found that the animals did not take to the cassava as well as they did to the sweet potatoes. By examining the cassava column in the table below it will be seen that the amount of cassava consumed each week was not constant like it was when sweet potatoes were fed. This was true of other animals fed on cassava, which were not in this experiment. The following table shows weight of animal and amount of feed consumed each week:

TABLE II.

DATE	LOGAN				JOE				FANNY				MAUDE			
	Corn	Hay	Cassava	Weight	Corn	Hay	Cassava	Weight	Corn	Hay	Cassava	Weight	Corn	Hay	Cassava	Weight
Jan. 26 Feb. 1.....	35	80	61	942	70	63	....	978	24.5	102	35	966	49	121	....	1088
Feb. 2-8.....	35	72	72	962	70	65	....	960	24.5	90	66	968	49	130	....	1042
" 9-15.....	35	85	81	968	70	86	....	972	24.5	102	64	968	49	133	....	1080
" 16-22.....	35	76	73	932	70	66	....	962	24.5	99	53	964	49	137	....	1040
" 23. Mar. 1....	35	84	73	932	70	72	....	960	24.5	110	54	970	49	128	....	1044
Mar. 2-8.....	35	87	67	940	70	87	....	964	24.5	106	46	976	49	130	....	1044
Total.....	210	484	427	....	420	441	....	....	147	609	320	....	294	779	....	....
Average.....	35	80.66	71.16	941	70	73.5	....	963	24.5	101	53.3	969	49	129.8	....	1040

A careful survey of the above table shows that the cassava was not as palatable as the sweet potatoes. The average amount consumed per day was much less and more irregular than when sweet potatoes were fed. The animals maintained their weights throughout the experiment, which may go to show that cassava is more concentrated than the sweet potatoes.

The large amount of hay consumed by Maude and Fanny was due to the small amount of concentrates offered.

After the cassava experiment was finished Joe was fed for six weeks on a ration of corn and cane syrup while Logan received a regular corn ration. The syrup used was some that was of low grade and had been around the place for two or three years.

No record was kept of the hay consumed in this experiment, as it ran fairly constant throughout the former experiments.

A low-grade syrup, which is a by product from the sugar

factories, is fed quite extensively on sugar plantations, and as the farmer sometimes has syrup left on hand which cannot be sold, but might be used for horse or hog feed it was thought best to make a test of its feeding value with what we had on hand. Sugar is highly digestible and is one of the most concentrated forms of carbohydrates. It is very soluble hence it is quickly taken up into the system and has proven valuable for feeding hard worked animals or for finishing a fat animal for the show ring. Prof. Henry, an authority on feeding, says that the feeding value of syrup is equal to that of corn, pound for pound. As our syrup was a little thin, 5 pounds was substituted for 4 pounds of corn in the ration fed to Joe. We have used syrup in preliminary tests with other animals and find that it is relished by all farm animals. In feeding, the syrup was given at night and morning and a larger corn ration given at noon.

The following table shows weight and amount of corn and syrup consumed per week:

TABLE III.

DATE	JOE			LOGAN		
	Corn	Syrup	Weight	Corn	Syrup	Weight
March 12-18	42	35	967	70	.....	935
" 19-25	42	35	976	70	.....	939
March 26. April 1.	42	35	971	70	.....	950
April 2 8	42	35	982	70	.....	940
" 9-15	42	35	982	70	.....	951
" 16-22	42	35	968	70	.....	948
Total	252	210	.....	42	.....	.....
Average	42	35	974	70	.....	944

Both mules remained in good condition during this experiment in spite of the fact that they were doing hard plowing throughout the entire time.

Considerable prejudice is held, by livery stable men and in the log camps, against the use of native hay for feeding work stock. We have used it exclusively for two years, and have never had any cause to regret its use. The chemical analysis of some of our native grasses is higher than that of Timothy, which is used almost exclusively in feeding horses.

In conclusion we might sum up by saying that:

Sweet potatoes may be substituted for one-half of the corn ration in feeding horses and mules doing hard work.

Cassava may also be used in about the same ratio as sweet potatoes, but is not so palatable to the animal.

Syrup may be fed to the work stock, provided it is mixed with chopped hay or something to give it bulk.

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29 The San Jose Scale.....	" 23	57 Top-working of Pecans.....	" 124
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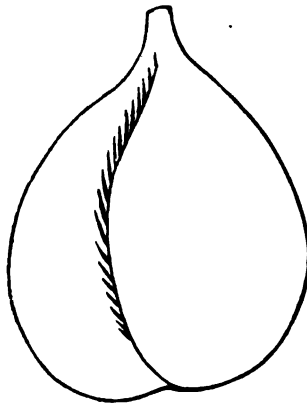
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	45 The Sugar-cane Borer.....

BULLETIN NO. 73.

JULY, 1904.

FLORIDA
AGRICULTURAL EXPERIMENT STATION

The
Honey Peach Group.



By F. C. REIMER.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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PLATE I



Honey Peach.

The Honey Peach Group.

Introduction

The peaches grown in this State comprise a large number of varieties, classified into six distinct groups. The leading varieties are included in three of these groups, viz: Peen-to, Spanish and Honey. The peaches belonging to the other three groups are grown only to a very limited extent. Two of these groups—Persian and Northern Chinese—are adapted to more Northern conditions and will not do well in our warm climate. The Oriental Bloods include a small number of varieties that do fairly well in some sections of the southern part of the State.

The Peen-to peach group includes a large number of varieties well adapted to central and some parts of South Florida. The history, varieties and importance of this group, have been thoroughly discussed by Prof. H. Harold Hume, in Bulletin No. 62, of this Station. The Spanish group includes more varieties than any other. The peaches, from which all of these varieties have sprung, were introduced into this State by the Spaniards several centuries ago. These peaches have become so well adapted to our climatic and soil conditions, and are so widely disseminated throughout our State, that they are often referred to as native peaches. Most of these varieties have originated in this State.

The Honey Peach group includes a large number of valuable peaches. They are distinct, both in form and flavor, from the fruit of all the other groups. They have a very rich, honey flavor, from which characteristic the group derives its name. With the excep-

tion of the parent—the Honey—and one or two other varieties, every member of the group originated in Florida; most of them have been originated by Mr. G. L. Taber, of Glen Saint Mary, Fla. This peculiar group of peaches, then, is another of the valuable acquisitions to Horticulture made by this State. These peaches ripen at a very desirable season—immediately following the Peen-to peaches.

The Honey group is well adapted to sub-tropical conditions, and is perfectly at home in the central and northern sections of Florida. It is especially well adapted to northern Florida, southern Georgia, Alabama, Mississippi, Louisiana and Texas.

As most of the peaches of this State are grown in central and north Florida, and as these groups—Peen-to, Spanish and Honey—are well adapted to these regions, it can readily be seen why these groups constitute most of the peaches grown in this State.

As nothing has ever been published, heretofore, on this interesting group of peaches, the necessity of a publication of this kind is apparent. This is intended to be a companion to Bulletin No. 62, Florida Experiment Station, on "The Peen-to Peach Group," by H. Harold Hume. Practically the same general outline that was adopted in that publication has been followed in this Bulletin.

Peach growing in this State is already an industry of considerable importance and is now increasing rapidly. Florida is so situated that she ought to place her peaches on the market earlier than any other State. Central and northern Florida are also well adapted to peach growing, and there are thousands of acres of land in these sections on which peaches can be, and will be, profitably grown. The conditions, however, are quite different here from those in other States, and somewhat different methods must be fol-

lowed in growing them. As there is no publication on peach culture, by this Station, and as frequent inquiries are made regarding the different phases of the work, such a publication will be issued as soon as possible.

Home of the Honey Peach.

The peach is a native of China. All the different groups have originated there or have originated from peaches which originally came from China. The Honey Peach originated in China, and undoubtedly has been cultivated there for many centuries, for it reproduces itself almost exactly from seed.

History of the Honey Peach in Europe.

The Honey peach has been grown in parts of Europe for over a half century. It was introduced into France shortly after it had been introduced into America. In 1852, M. Montigny, French Consul to Shanghai, sent stones of the Honey peach to the Jardin des Plantes, Paris, France. An old synonym for the Honey peach was *De Montigny*, which was applied to it because of this French Consul having introduced it.

This seed was planted and the seedlings fruited for the first time in 1860, the variety being described in 1861, by M. Carriere in *Revue Horticole*, page 11. It was introduced into England, from France in 1862. According to Robert Hogg* the name Honey Peach, had its origin in England, for he says: "The name Honey Peach, which has been given it in England, is expressive of the peculiar richness of its flavour." This cannot be true, however, for J. T. Devan referred to them as *Honey Peaches* in 1846—sixteen years before they were introduced into England.

* Robert Hogg, *The Fruit Manual*. 5th Edition, Pp. 450.

History of the Honey Peach in America.

Although there is now a large number of varieties of Honey peaches cultivated in America, and all of these except the original variety—Honey—have originated in America, yet the history of this group in America covers a period of only a little more than half a century. Furthermore, it was not cultivated to any great extent previous to 1870. Most of the varieties belonging to this group have originated in Florida, and since 1885.

In 1846, A. J. Downing, of Newburg, N. Y., received from one of his neighbors, John Caldwell, some peach pits, which had been sent to Mr. Caldwell by one of his friends, Dr. J. T. Devan, of Canton, China. Dr. J. T. Devan in his letter to John Caldwell speaks of them as "pits of the Honey Peach." Downing, in the *Horticulturist*, speaks of them as "some stones of what is evidently a new and very distinct kind of peach."

The following extract is from J. T. Devan's letter to Mr. Caldwell: "I have received as a present from a Chinese gentleman a few 'Honey peaches.' I have never been able to procure any such at the fruiterers.

"I herewith send you the pits. These peaches are remarkable for their honied sweetness, and are ripe about the first of June. Their shape is also peculiar, it being like the sketch* on the opposite side of this paper, form, pointed at one end, rich yellow and red in colour, very deeply grooved, and about the size of this sketch. Yours with respect, J. T. Devan." (*Downing's The Horticulturist*, Vol. 1.) This letter was dated Canton, June 18, 1846.

♦ This is the earliest introduction of the Honey peach, and the only one ever made, so far as is known to the writer.

This letter leads one to infer that the Honey peach may have

* Reproduced in Frontispiece of this Bulletin.

been cultivated only to a very small extent at that time, for he says "I have never been able to procure any at the fruiterers." Yet it is very probable that it had been cultivated for a long time, for, according to Downing's "Fruits and Fruit Trees of America," this Honey peach reproduced itself with great exactness. Downing planted these pits, but fearing that the climate of Newburg, N. Y., would be too severe, he sent cuttings from the seedlings to Mr. Henry Lyons, of Laurel Park, Columbia, S. C. Mr. Lyons planted these cuttings and on July 30, 1856, obtained his first fruit, consisting of three peaches. This is the first time that this peach fruited in America. Mr. Lyons says that the fruit he obtained "corresponds very nearly with the plate." He adds further: "I exhibited it on yesterday to the fruit committee of our State Agricultural Society; all agreed it was the most remarkable, distinct and richest peach they ever tasted."

In 1857 Mr. P. J. Berckmans, of Augusta, Ga., propagated, by contract, a few hundred trees of this Honey peach, for Mr. Henry Lyons. In 1858 Mr. Berckmans purchased these trees of Mr. Lyons, with full and sole right to propagate and sell. These trees were then put upon the market without restrictions as to propagating, and were distributed throughout the South. The various nurserymen of that time then began propagating it and in this way the Honey peach was soon dissiminated throughout various sections of the South.

James Fitz, in "The Southern Apple and Peach Culturist" (1872), speaks of the Honey peach as "A new variety from South Carolina, where it ripens the last of June." By this time, however, it had found its way into the various fruit sections of the Central and South Atlantic States, as is shown by the many fruit lists given by nurserymen and Horticultural Societies of that time.

In 1878 Mr. P. J. Berckmans originated a new variety, Pallas, which is a seedling of the Honey peach. This variety is still under cultivation and is one of the leading varieties belonging to the group.

Characteristics of the Group.

The trees are large, vigorous growers, upright spreading in habit, prolific and bear at an early age. The leaves are dark green in color, long, narrow, pointed, finely serrated, and have two to four reniform glands at the base. The flowers are numerous, large, either solitary or in clusters, and of a crimson color, with base of petals often bright red. In shape the fruit is distinct and varies slightly, generally being rounded, oblong with a peculiar, long, conical apex which is more or less recurved. In size it varies from medium to large, most of the varieties being larger than the parent—Honey. The color is a light yellow or white covered with red on exposed parts. The skin is more or less fuzzy and adheres closely to the flesh. The flesh is firm, meaty and very juicy, generally white in color, and often streaked with red about the stone. In flavor they vary slightly, being sweet, or subacid, and the original Honey has a distinct honey flavor. The stone is free, or cling, deeply furrowed, generally curved, long pointed, and always corresponds to the fruit in shape. The ripening season lasts from June 1st until July 15th; there is little danger of the flowers being killed by late frosts.

Varieties.

Since the introduction of the Honey peach seventeen varieties have been listed by Florida nurserymen. About one-third of these have proved practically worthless and are no longer catalogued.

The Honey is no longer considered a good commercial peach. It has given place to newer and better varieties.

Owing to the extreme drought which was experienced during the past spring the peaches were under-sized in nearly every instance, therefore due allowance must be made for the measurements.

The ripening season also varies considerably in different parts of the State. For instance, the peaches grown near the ocean, along the St. Johns river, were at least one week earlier than those grown at Glen St. Mary, and also Komoko, Fla., although the latter place is at least 50 miles further south, but near the center of the State.

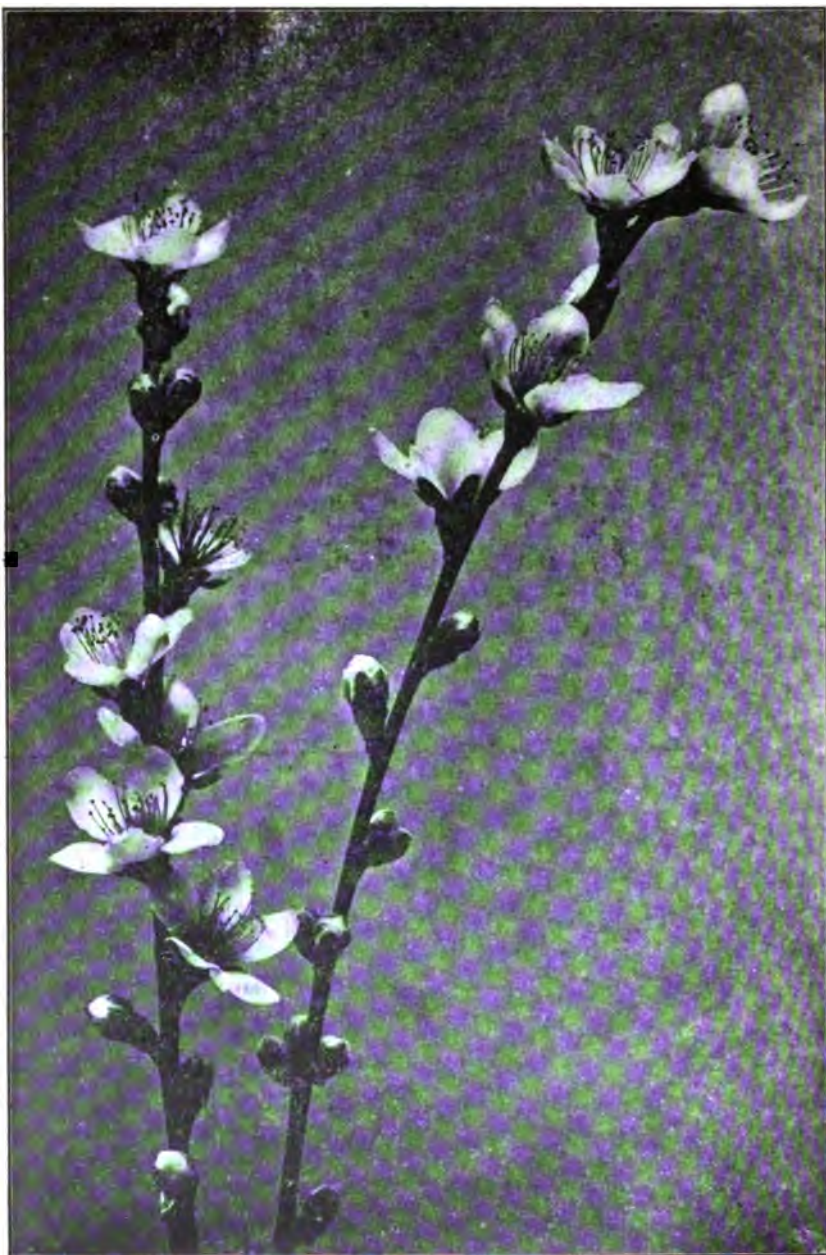
The description of the Honey, the progenitor of the whole group, is given first, after which the varieties are arranged alphabetically.

Honey. (*Downing's—The Horticulturist*, 1846—page 382.)
(*Berckman's cat.* 1858.)

Form oblong, pointed; size medium, 1 7-8x1 3-4x1 5-8, 2x1 5-8 x1 5-8 inches; color whitish yellow washed and dotted with red, especially on sunny side and base end; apex long, re-curved, distinctly conical, sharp; cavity deep, narrow, dull yellow in color; stem short, 1-4 inch long, stout; suture distinct, grooved from base to apex; skin slightly rough, fuzzy, thin, medium tough; flesh compact, juicy, creamy white, streaked with red about the stone; flavor a distinct, rich honey; quality very good; stone free, elliptical, long point, deeply furrowed and pitted, reddish brown, medium in size, 1x1-2x3-8 inch; season June 1st to 15th.

Tree a vigorous grower, upright spreading habit, bark reddish brown. At present this is not a favorite commercial peach.

PLATE II



Flowers and buds of Honey Peach.

Introduced into America in 1846 by J. S. Devan, of Canton, China. Introduced into the South in 1858 by P. J. Berekmans, of Augusta, Ga.

Described from specimens received from the Griffing Bros. Co., Komoko, Fla.

Climax. (*Taber's cat.* 1887-88.)

Form roundish oblong; size medium, 2 1-8x1 3-4x1 3-4, 2x1 7-8 x1 5-8 inches; color greenish yellow washed with red; apex conical, distinct, straight or slightly recurved; cavity shallow and open; stem short and stout; suture running from base to apex, very deep near base, often split; skin fuzzy, thin and rather tender; flesh white, tinged with red about the stone, firm, meaty, juicy; flavor sweet, rich, very agreeable; quality excellent; stone free, elliptical, long with a long recurved point, deeply furrowed, light brown, basal half blood red, 1 3-8x3-4x1-2 inch; season June 15 to July 1.

The tree is a rapid upright grower and good bearer. The fruit is excellent and is a good shipper. A seedling of Honey.

Described from specimens received from Jarvis & Dockrell, Fulton, Fla., and the Griffing Bros. Co., Komoko, Fla.

Colon. (*Taber's cat.* 1893-94.)

Form roundish oblong; size large, 2x1 3-4x1 1-2 inches; color yellowish white, splashed and dotted with bright red; apex recurved, conical with sharp point; cavity deep and open; stem short and stout; suture distinct, shallow except near base; skin smooth, slightly fuzzy, thin and tender; flesh white streaked with red, bright red about the stone, juicy; flavor sub-acid, spicy; quality very good; stone free, elliptical, sharply pointed, deeply furrowed and pitted, reddish, large, 1 5-8x3-4x5-8 inch; season, June 10 to 25.

This is a seedling of a Honey seedling, originated by G. L. Taber, of Glen St. Mary, Fla., in 1892.

Described from specimens grown at the University of Florida.

Early Cream. (*Taber's cat.* 1888.)

The following description is copied from Mr. G. L. Taber's catalogue for 1891-92:

"Seedling from the Honey. Size large, of handsome appearance and fine quality; freestone. This resembles Kite's Honey so strongly that the two varieties are believed to be identical. As this variety has been largely advertised, however, under this name, it is herewith offered with this explanation. Buds of this variety were obtained direct from the introducer."

Mr. Taber's Catalogue for 1891-92 lists the two as synonymous, giving Early Cream the preference, and Kite's Honey seems to have then dropped out of existence, as far as name is concerned.

It was impossible to obtain specimens of this variety for description.

Ferdinand. (*Taber's cat.* 1893-94.)

Form rounded, oval, flat, bulged on one side; size medium to large, 1 3-4x1 13-16x1 11-16 inches; color dull yellow, well covered with dull red; apex short, blunt, recurved; cavity abrupt, deep, narrow; stem short and stout; suture a mere line; skin velvety, thick and tough, adhering closely to the flesh; flesh firm, meaty, juicy, white, streaked with red, bright red about the stone; flavor insipid, poor; quality poor; stone cling, oval, plump, short, straight point, deep red, 1 1-4x3-4x5-8 inch; season July 1st to 15th.

This peach is a seedling of the Honey seedling and was originated by Mr. G. L. Taber, of Glen St. Mary, Fla., in 1892. This is a good commercial peach, although of poor quality.

Described from specimens received from the Griffing Bros. Co., Komoko, Fla.

Florida Gem. (*Taber's cat.* 1890-91.)

Form oval in outline, almost three-sided; size medium to large, 1 3-4x1 3-4x1 1-2 inches; color greenish yellow, washed with deep red on exposed parts; apex conical, long, recurved, very prominent; cavity open, wide, abrupt, medium deep; stem short and rather thin; suture an indistinct line, almost wanting; skin even, fuzzy, thin, tough, adhering closely to flesh; flesh firm, juicy, white, with a trace of pink about stone; flavor very sweet, agreeable; quality of the best; stone free, elliptical, straight with recurved point, reddish, 1 1-8x5-8x1-2 inch; season June 20th to July 5th.

This is a seedling of the Honey. It is one of the best Honey peaches for both home and commercial purposes.

Described from specimens received from the Griffing Bros. Co., Komoko, Fla.

Hastings.

Form oval, very irregular, nearly three-sided; size medium to large, 1 3-4x1 3-4x1 3-4, 1 7-8x1 3-4x1 5-8 inches; color dull greenish yellow, well washed and streaked with deep red; apex conical, distinct, slightly recurved, medium in length; cavity abrupt, deep, rather open; stem short and medium thick; suture a mere line; skin very fuzzy, thin, tough and adhering closely to fruit; flesh firm, meaty, juicy, with faint trace of red about stone; flavor sweet, of good character; quality excellent; stone free, oval, plump, with broad recurved point, red, 1 1-8x3-4x9-16; season, June 20th to 30th.

This is a new peach originated by the Griffing Bros. Co., Macclenny, Fla., about 1900. It is destined to become a prominent commercial and home peach.

Specimens received for description from Griffing Bros., Komoko, Fla.

PLATE III.



Imperial Peach Tree.

PLATE IV.



Fruit of Imperial Peach.

Imperial. (*Taber's cat.* 1890-91.)

Form roundish oblong, irregular, often flat and bulged on one side; size large, 2x2x1 3-4, 2 1-8x1 3-4x1 3-4 inches; color greenish yellow, slightly washed with red on exposed side; apex long, conical, recurved, and slightly pointing towards one side; cavity deep, wide and open; stem short and stout; suture deep near base in some, in others a mere line; skin very fuzzy, becoming smooth as it ripens, thin and tough, adhering closely to flesh; flesh white, firm, meaty and juicy; flavor sweet, excellent; quality very good; stone free, oblong, recurved, long sharp point, plump, deeply furrowed, light brown often bright red in furrows, large, 1 1-4x3-4x1-2 inch; season June 15th to 30th.

This is undoubtedly one of the very best peaches belonging to the Honey group; the tree is a vigorous upright grower and heavy bearer; the fruit is firm and stands shipping well.

This is a seedling of the Honey and was originated by Mr. G. L. Taber, of Glen St. Mary, Fla., in 1890.

Described from specimens received from Messrs. Jarvis & Dockrell, Fulton, Fla.

Kite. (*Taber's cat.* 1888.)

The following description is copied from Taber's supplement to price list of 1888-89: "A seedling of the Honey, supposed to be crossed with Peen-to. A magnificent peach, much larger than the Honey, measuring two by two and one-half inches in diameter; resembles Honey in shape, but without so sharp a point. Skin yellow, washed and flecked with red. Flesh fine-grained, sweet juicy, and of excellent flavor. Perfect free stone. The original tree is a strong grower, and has borne heavy crops for four years. Fruit very smooth, ripens uniformly and never cracks. Ripens June 15th to 25th."

Kite's Honey.

The following description is copied from Mr. G. L. Taber's Catalogue for 1889-90:

"Seedling of the Honey, supposed to be crossed with Peen-to. A magnificent peach, much larger than the Honey, measuring two by two and one-half inches in diameter. Resembles Honey in shape, but without so sharp a point; skin yellow, washed and flecked with red; flesh fine-grained, sweet, juicy and of excellent flavor; perfect freestone. The original tree is a strong grower, and has borne heavy crops for four years. Fruit very smooth, ripens uniformly and never cracks. Quality best. Ripens June 15th to 25th."

Oviedo. (*Taber's cat.* 1895-96.)

Form roundish oblong, bulged on one side; size large, 2 1-4 x 1 7-8 x 1 7-8, 2 x 1 3-4 x 1 3-4 inches; color greenish yellow, marbled with dull red on exposed parts; apex short, recurved, cavity shallow, open and regular; stem short and thick; suture a mere line, deeper near basal end; skin fuzzy, becoming smooth as it ripens, thin and tough; flesh firm and meaty, white, red about stone, juice not plentiful; flavor sweet and agreeable; quality very good; stone free, elliptical, curved, with long recurved point, deeply furrowed, light brown, partially covered with blood red, 1 1-2 x 3-4 x 1-2; season, June 20 to 30.

This is one of the best Honey peaches; the tree is a rapid grower and heavy bearer; and an excellent peach for shipping.

It is a seedling of the Honey and according to the Griffing Bros. Co. Catalogue, this peach was originated in 1892 by S. J. Kennard, of Waldo, Fla.

Described from specimens received from Jarvis & Dockrell, Fulton, Fla.

Pallas. (*Berckman's cat.* 1878.)

Form nearly round, slightly pointed; size medium to large, 2x1 3-4x1 3-4 inches; color light yellow, well covered with deep red; apex straight, short, cavity deep and narrow; stem short and medium thick; suture deep on basal half, mere line above middle; skin fuzzy and velvety, thin, tender, loosely attached to flesh, not bitter; flesh white, mealy, soft and rather juicy; flavor slightly acid, with rich, sprightly, vinous aroma; quality excellent; stone free, oval, straight point, pits and furrows shallow, bright red, 1 1-4x3-4x1-2 inch; season June 15 to 30.

It is a seedling of Honey and was originated in 1878 by Dr. L. E. Berckmans, of Augusta, Ga.

This is a peach of excellent quality and one of the best Honey peaches for home purposes. It is not considered a very good commercial peach, as it is a poor shipper.

Described from specimens received from Messrs. Jarvis & Dockrell, Fulton, Fla.

Sangmel. (*Taber's cat.* 1893-94.)

Form oblong, bulged on one side, slightly pointed; size medium, 1 3-8x1 1-2x1 3-8 inches; color light yellow, exposed parts streaked with deep red; apex pointed, straight, blunt; cavity abrupt, narrow and rather deep; stem short and thick; suture barely marked at cavity; skin smooth, velvety, thin, tender, separating easily from the flesh; flesh firm, meaty, juicy, yellowish, red just beneath the skin and pink about the stone; flavor sweet, slightly sub-acid and of good character; quality of the best; stone free, straight, elliptical, pointed, pits and furrows medium deep, brown with tinge of red, 1 1-8x5-8x1-2; season June 25 to July 10.

This peach is a Honey seedling and was originated in 1892 by Mr. G. L. Taber, Glen St. Mary, Fla.

Described from specimens obtained from the Griffing Bros. Co., Komoko, Fla.

Stanley. (*Griffing Bros.' cat.* 1889.)

Form roundish oblong; size medium to large, 2x1 7-8x1 7-8, 1 3-4x1 3-4x1 3-4 inches; color greenish white, washed and marbled with deep red on exposed parts; apex short, conical, nearly straight; often a mere point; cavity deep, rather open; stem short and thick; suture well marked, deep near base, often split; skin thick and tough, fuzzy; flesh white, rather soft, easily breaking down; flavor insipid, sweetish, with a tinge of bitter about the stone; quality poor; stone cling, oblong, plump, with blunt point, dull brown, large, 1 1-8x5-8x1-2; season June 10 to 20.

This peach is a seedling of the Honey and was originated at the Griffing Bros. nursery at Macclenny, Fla.

This variety is very subject to brown rot, and easily breaks down in transportation, hence a poor commercial peach.

Described from specimens received from Jarvis & Dockrell, Fulton, Fla.

Taber. (*Taber's cat.* 1893-94.)

Form roundish oblong, pointed; size large, 2 1-2x2x1 7-8 inches; color white and well covered with red; apex conical, long, recurved; cavity abrupt, deep and open; stem short and stout; suture well marked at basal end; skin fuzzy, thin and tender, not bitter; flesh white, streaked with red, red about stone, firm, juicy; flavor sub-acid, rich; quality of the very best; stone cling, elliptical, recurved, pointed, furrowed and pitted, brown, large, 1 1-4x3-4x1-2; season June 15 to 25.

A seedling of a Honey seedling; originated by Mr. G. L. Taber, Glen St. Mary, Fla., in 1892.

This is a heavy bearer, of excellent quality and a good home

peach; it often cracks in the suture, hence it is not so desirable as some other Honey peaches for commercial purposes.

Triana. (*Taber's cat.* 1893-94.)

Form roundish oblong, slightly pointed; size large, 2 1-8x1 7-8 x1 7-8 inches; color yellowish white, exposed parts washed with maroon; apex conical, blunt, slightly recurved, cavity deep and rather open; stem short and thick; suture deep on basal half, a mere line above the middle; skin fuzzy but quite smooth when thoroughly ripe, thin tender, bitter, adhering closely to flesh; flesh white, marked with red about stone, meaty, juicy; flavor sweet, spicy and very agreeable; quality excellent; stone free, oval, plump, point long and recurved, furrowed, bright red, large 1 5-16x3-4x1-2; season June 20 to July 5.

It was introduced by Mr. G. L. Taber, of Glen St. Mary, in 1892.

This is one of the best Honey peaches. It is of excellent quality, a good bearer and shipper.

Described from Specimens obtained from Messrs. Jarvis & Dockrell, Fulton, Fla.

Townsend. (*Taber's cat.* 1892-93.)

The following description is taken from the catalogue referred to above: "Seedling from the Honey. Fruit large, oblong; color greenish yellow, washed with red; flesh white, juicy; excellent flavor; perfect free stone. Ripens July 1st to 10th."

This peach has not been listed in fruit catalogues for a number of years. It was probably just a different name for some other variety of the Honey group.

Recommendations.

This group of peaches is well adapted to central and northern Florida. It is also at home in the southern portion of Georgia, Alabama, Mississippi, Louisiana and Texas. These peaches can endure more cold and are later than those belonging to the Peen-to group and therefore should be more largely planted in the northern section of the State.

The Honey variety, which is the parent and progenitor of this whole group of peaches, is no longer a favorite. It has been in cultivation so long that it has, like all other fruits, given way to newer and better varieties. Or, as the growers term it, "It is worn out." It cannot be recommended for extensive planting.

The selection of varieties is so much a matter of personal taste and local conditions that it is almost useless to attempt to give a list of the varieties. In central and northern Florida, Colon, Florida Gem, Imperial and Triana are the favorite varieties.

In West Florida and the southern half of the Gulf States, Colon, Climax, Florida Gem, Imperial, Pallas, Taber, and Triana are the favorite varieties.

Acknowledgments.

The writer wishes to acknowledge the valuable assistance received from Prof. H. Harold Hume, G. L. Taber, of Glen St. Mary, Dr. P. J. Brackett, Pomologist, Washington, D. C., and P. J. Berckmans, Augusta, Ga. He also wishes to thank the Griffing Bros., of Komoko, Fla., and Messrs. Jarvis & Dockrell, of Fulton, Fla., who furnished most of the varieties for description.

PLATE III.



Imperial Peach Tree.

PLATE IV.



Fruit of Imperial Peach.

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Anthracnose of the Pomelo.

Attention was called to this disease in Bulletin 53, Florida Experiment Station, under the name, Leaf-Spot, as at that time it was observed only upon the leaves.

Distribution of the Disease.

During the past fruit season, 1903-1904, a new disease appeared on Pomelo fruit in a number of different sections in the State, and a careful examination of the fruit, both in the field and in the laboratory, proved that this new disease was caused by the same fungus, *Colletotrichum gleosporioides* Penzig, as causes the Leaf-spot. Early in the season it was observed in two or three different and widely separated groves in the eastern part of the State, and a little later, diseased fruit was forwarded from West Florida. Later on, investigation of the fruit in a number of groves in the western part of the State showed that the disease was widely distributed in that section. Specimens of fruit were also received from a number of different points in the interior of the State. An examination of the pomelos held for sale by the fruitiers in Jacksonville, Florida, showed that the disease must have been quite prevalent throughout the State. It was almost impossible to find any considerable amount of fruit exposed on the fruit stands in which a few diseased specimens at least could not be found.

From these observations we may safely conclude that the disease on the fruit is likely to occur in any portion of the State and that it is at the present time widely distributed, though, as pointed out later on, there appear to be certain conditions especially favorable to its development.

This disease on the fruit was first observed by the writer in the autumn of 1901, but attracted little attention at that time, as

the damage was slight, only a few specimens of diseased fruit having been observed in a single grove. Since that time the disease, in the grove where it was first observed, has increased to such an extent that the trees, on which it was first noticed, yielded a very small proportion of sound fruit during the present season. The disease has probably been at work for a considerable length of time, and as is usual in such cases, attracted little attention until it became serious. The loss during the past season in two or three instances has amounted to from five hundred to a thousand dollars in a single grove.

From our present knowledge of this disease it appears to be on the increase and we are probably justified in predicting that it has not yet reached its worst. The disease is in all likelihood an introduced one and it may be looked to attack the sweet orange in addition to the lemon, lime and pomelo. It frequently occurs upon leaves, twigs and branches of the sweet orange, and on one occasion sweet orange fruit on one of the fruit stands in Lake City, Florida, were observed, covered by lesions (diseased spots) caused by this same fungus *Colletotrichum gleosporioides*.*

The Disease on the Leaves.

On the leaves, the disease first appears in the form of rather irregular areas from 1-8 to 3-4 inch across. Occasionally they become confluent or join each other so as to embrace a large portion of the surface of a leaf. The spots vary in color from brownish yellow to a dark shade of brown, depending upon the stage of development. Usually the diseased spots are located near and extend to the margin of the leaf. The tip is quite a favorite seat of infection, the lesions (diseased spots) may however be located on the leaf entirely removed from the margin. The characteristic color noted above marks the commencement of the disease, the period during which the mycelium (fungal threads) is growing most actively in the tissues of the leaf.

* This same disease also attacks the lemon and lime. See Bul. 52. Bureau Plant Industry, U. S. D. A., by Prof. P. H. Rolfs.

PLATE I.



Anthracnose on Pomelo leaves. All the light areas are diseased in various stages.

As the disease progresses, the affected area becomes more clearly defined. The areas representing a number of separate spots of infection, close to each other, become continuous. The color changes from yellowish to the gray hue of dead tissue. The line of division, between the dead and the green, living tissues, is slightly elevated and as already noted, clearly defined. At this stage, a close examination of the discolored spots on the upper side of the leaf reveals the presence of a number of minute dark dots. These dots are arranged more or less completely in concentric circles or ovals. These minute dark dots are in reality the spore bearing parts of the fungus (ascervuli) containing in large numbers, the spores, by means of which the disease is spread from one portion of the tree, from one tree, or from one grove to another. The affected, or diseased areas are usually located near the tip or side of the leaf, though they may be situated in the central portion of the blade (Plate 1.)

Anthraxnose on the Twigs.

Small twigs are very frequently attacked. Occasionally the disease seems to progress from an infested leaf to the twig upon which it is borne. Twigs injured by cold or insects are usually attacked. Soon after the entrance of the fungus, the twigs attacked become gray and dead. Many pomelo trees may be seen throughout the State in which numerous twigs and small branches, killed by the disease, may be found in the interior of the top. Usually the twigs in proximity to diseased fruit are also found to be diseased or dead (See Plate II.)

The Disease on the Fruit.

The fruit may be attacked either on the tree or after it is removed. Specimens of rind, removed from fruit which had been shipped to Chicago, have been examined, on which the disease was present. It was said to have been perfectly sound at the time of shipment.

The most conspicuous damage, during the time the disease has

PLATE II



Pomelos on the tree attacked by Anthracnose. Each fruit marked with an X is diseased. Note that the twigs have been defoliated. Most of these twigs are dead. More than a box of fruit was diseased on these branches.

been under observation has been to the fruit while it still remained on the tree. Upon the fruit the presence of the disease is first manifested by an irregular brownish discoloration. The discolored area is irregularly defined around the margin. The diseased spot may be on any portion of the fruit and may vary from an inch or so in diameter to an area nearly equal to that of the outside of the fruit. As it progresses these spots gradually change in color, sometimes becoming grayish, sometimes somewhat lighter. Ultimately, however, the whole affected area becomes dirty black in color. If the point of infection is small at first it gradually enlarges under favorable conditions so as to embrace the whole fruit. Sometimes the affected area remains constant in size for a considerable time, in which case in its older stage it varies from black at the centre through various shades of brown, brownish yellow to the normal yellowish color of the healthy rind at the margin.

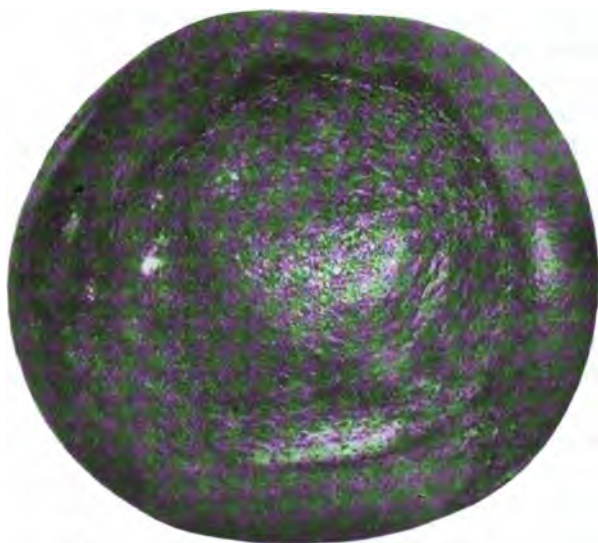
The black discoloration is caused by the formation of the spore bearing parts. These dark fruiting bodies are so numerous as to make the fruit black. Under a hand lens they seem to be rather irregular in size and shape, and are elevated above the surface of the diseased rind. The outer ends of the oil cells are depressed, the depressions showing a wrinkled appearance. From these fruiting bodies sporules or spores are produced. They are very minute, measuring only from 16-18x4-6 microns.* Under the microscope they are seen to be cylindrical, rounded at the ends and hyaline in color. They have but one cell. Frequently minute, round, light colored areas may be made out in them.

The disease starts at the outside of the fruit and works inward as well as around it. The mycelium of the fungus seems to progress more rapidly toward the centre of the fruit along the partitions or dividing septa than it does through the pulp; but it grows in both. The mycelium is branched and grows at will; first through the inner portion of the rind, later entering the fruit.

The disease is confined to the rind for a considerable period

* A micron equals 1-2500 of an inch.

PLATE III.



Advanced Stage of Anthracnose on Pomelo fruit.

and the flavor of that portion of the pulp immediately beneath the seat of infection is normal for some time, while the opposite side of of the fruit retains its normal quality for a much longer period. Ultimately, however, the flavor of the whole fruit is distinctly altered. The bitterness in the flavor is probably unchanged, but the acid and sugar in the juice are either broken down or destroyed. In consequence the bitter taste is very strong and being unmodified by either sweetness or acid, is quite disagreeable. Besides this the juice and pulp are permeated by the flavor of decay and emit the distinct odor of citric acid.

While fruits attacked by the disease usually present the appearance already described, at other times the trouble manifests itself by the appearance of a large number of circular or more or less irregular brown areas. (See Frontispiece). The rind immediately beneath and surrounding these areas is depressed, but in the centre the discolored spots are frequently somewhat elevated. They become more prominent as the rind dries, contracts and becomes thinner. When placed in a moist chamber the disease soon embraces the whole fruit and the rind becomes very dark in color, owing to the large number of fruiting bodies of the fungus formed.

As a general rule, all fruits attacked, drop soon after the fungus becomes well started. Some of it remains on the tree for a considerable time, but if attacked near the stem it always falls. On the ground, beneath the branches, shown in Plate II, there were nearly as many fruits as are shown on the branches.

Suggested Causes of the Disease.

It has been stated by growers that the disease was caused by spraying, by the effects of cold, or by the strong sunlight. While it must be recognized that any condition which reduces the vigor of the tree, or any part of it, acts as a predisposing cause; still the immediate cause of the disease is the fungus already referred to and were this not present the disease would not occur. It has been found on sprayed and unsprayed trees, on fruit in the sun and

in the shade. The fruit may be affected on any part, base or apex, on the side facing outward when hanging on the tree, or on the inner side. It has been found in sections where no fruit was touched by frost. It has been found on fruit well up in the tops of the trees and on fruit borne on the lower branches and touching the ground. From these facts we must grant that neither spraying, frost, sun, shade, nor the position of the fruit on the tree has anything to do with the cause of the disease. It is probably true that the fruit near the ground where the air is moist and where the fruit is more shaded may be more subject to the disease. Aside from this, the position of the fruit has no bearing on the virulence of the disease or in rendering the fruit more susceptible to attack.

Conditions Favoring the Disease.

Starved Condition of the Tree. In animal so in vegetable life; a vigorous well-fed individual withstands disease while the weak, starved one succumbs. The pomelo is naturally a vigorous grower and we are probably not far astray, when we say that compared with sweet orange trees of equal size and age they require from one-fourth to one-third more fertilizer. In a number of instances poorly fed trees have been attacked on leaf, branch and fruit by the disease, while better nourished ones immediately adjoining showed no signs of its attack.

The remedy in this case is obvious.

Wind. Where trees have been badly whipped by the wind, causing abrasions on the fruit and branches and tearing the leaves, the disease adds to the injury already done. The wounded spots are very readily attacked. On the other hand trees standing in still areas, where there is little or no air movement are more subject to attack than are those about which the air circulates freely. The trees should not be subjected to the whipping force of the wind, neither should they be so hedged in or walled about by standing timber as to prevent a free circulation of air. In the matter of forest protection the middle course should be pursued.

Frost. The disease usually follows injury to the leaves,

branches and fruit by frost. The spores of the fungus gain access to the tissues through the parts injured.

Disease. Trees suffering from Die-back, Foot-rot, or any other disease are more subject to the attacks of Anthracnose than are those which are entirely healthy. For control of these diseases, see Bul. 53, Florida Experiment Station.

Insects. These devitalize the trees and puncture the tissues thus making it possible for the fungus to gain a foothold. Among those insects which appear to assist in increasing the attacks of the fungus may be mentioned the different scales and mites in particular. Spots upon citrus leaves immediately beneath clusters of long or purple scales are generally found to be diseased and it is probably not too much to say that insects open up the way for the fungus to enter leaf, branch or fruit.

Bruises. The slightest abrasion of the surface of the fruit opens up a way for the entrance of the fungus; the greatest care should be exercised in handling the fruit to prevent injury to the rind.

Remedies.

Removal of Diseased Fruit. All diseased fruit should be taken from the trees and if any should have fallen to the ground, it, too, should be collected. Destroy all badly affected fruit; either bury it deeply or burn it. Fruit showing only slight effects of the disease may be sold in the nearby markets. In the packing house all fruit should be kept where fresh, dry air will have free access.

Pruning. Cut out and burn all dead and diseased branches. Rake up and burn all leave lying about and under affected trees.

Spraying. Trees on which diseased leaves and branches appear should be thoroughly sprayed with Bordeaux Mixture early in the season (May, June, July). If spraying is needful and desirable as the fruit nears maturity, spray with Ammoniacal Solution of Copper Carbonate. Three or four applications at intervals of ten days may be necessary. Mr. E. P. Porcher, Cocoa, Fla., successfully combatted this disease and stayed its progress by this means

PLATE IV.



Fruit Washer used by W. S. Hart, Hawks Park, Fla. Operated by a small gasoline engine. This washer is one of the best.
Manufactured by S. C. Warner, Palatka, Fla.

on our recommendation. Bear in mind that every application of a fungicide to a citrus tree should be followed by a good insecticide to keep down the scales.

Fruit on which the disease is likely to be present should be sprayed before or after removal so as to prevent its development on the way to market. Directions for the preparation of spraying mixtures will be found in Bulletin 72, Florida Experiment Station.

Washing. Many growers wash their fruit before shipping it. Ammoniacal Solution of Copper Carbonate may be added to the water used in washing. Another good substance for this purpose would be Potassium Sulphide. One of the best washers is that manufactured by S. C. Warner, Palatka, Fla. (See Plate IV). No better means of control can be devised than this, but the exact amounts which it would be best to use have yet to be determined.

H. HAROLD HUME.

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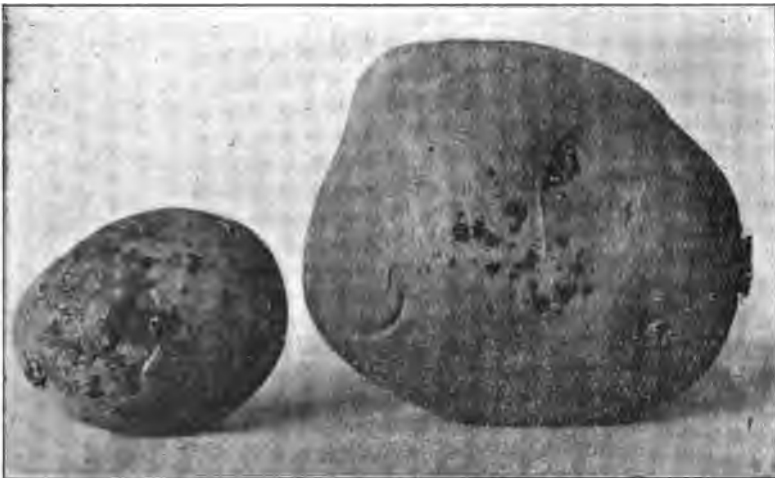
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BULLETIN NO. 75.

AUGUST, 1904.

FLORIDA
AGRICULTURAL EXPERIMENT STATION

Potato Diseases.



By H. HAROLD HUME.

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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Potato Diseases.

H. HAROLD HUME.*

In this country, the following diseases have been injurious to the Irish potato crop: Late Blight, Early Blight, Scab, Bacterial Blight and Sterile Fungus. Lately a disease, designated as "Dry Rot," due to *Fusarium oxysporium* has been described, by Dr. Erwin F. Smith and Dean B. Swingle in Bulletin 55, Bureau of Plant Industry, U. S. D. A. This last mentioned disease is not known to occur in Florida, though it may be present, but all the other diseases mentioned above, may be found in the potato fields of the State.

Of these diseases the one which has attracted most attention in Florida is the Late Blight.

Late Blight.

(*Phytophora infestans* DeBary.)

This disease did not attract attention in Florida until the spring of 1903, when the potato crop of Hastings, the principal potato producing section of the State was reduced from twenty-five to thirty per cent by it. Complaints were also received that the potatoes did not arrive in good order, though apparently sound at the time of shipment. They had decayed in transit.

Late Blight, is caused by a fungus, *Phytophthora infestans*, which attacks both the tops (stems and leaves) and the tubers. In the early stages of the disease, the spots on the leaves are quite characteristic. The edges or tips of the leaves are usually

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attacked first. The diseased areas stand out in marked contrast to the uninjured parts of the leaf. The former varies from dark brown or almost black to lighter shades, while the normal color of the healthy leaf is a deep, dark green. Between the healthy and diseased tissue of the leaf, the line of division, in the form of a narrow yellowish band, is very distinct.

Under certain weather conditions a downy, whitish growth is distinctly visible on the under sides of the leaves. This growth consists of the innumerable spores and spore bearing parts of the fungus. By means of the spores the disease is spread rapidly. They are scattered by the wind, rain and other agents and lighting upon the leaves, germinate immediately and give rise to the same diseased conditions as were present on the leaf from which they came. Presently the whole field looks as though the plants had been scorched by fire—all are dead and dry.

These same spores or *conidia*, as they are called, are also responsible for the rotting of the tubers. The spores are washed from the plant down along the stem and into the ground to the tubers. The swaying of the plants in the wind doubtless assists in this downward journey. Many are brought in direct contact with the tubers and upon germination an entrance into the potato is effected. The normal white color of the potato soon changes to a dirty brown as a result of its inroads. If the ground is dry and remains so for a considerable time "dry rot" results, but if any considerable amount of moisture is present, the tubers decay rapidly, becoming nothing but a pulpy, ill-smelling mass. The progress of the rot in the tubers is well brought out in Fig. A, Plate IV. It progresses from the exterior towards the center of the potato. It does not advance regularly, but may penetrate much more deeply in one part than in another.

Besides the spores mentioned above, another kind of spores, termed "resting" spores, "winter" spores or "oospores," is sometimes produced. In northern regions these are formed in autumn in the tissues of the plant and serve to carry the disease through the winter. Upon the return of warm weather, the tissues of the potato stems become thoroughly decayed and these thick-coated winter spores are liberated. They are scattered in various ways and under favorable conditions soon give rise to the disease again.

Whether these spores are produced in Florida has not been definitely determined, but it is not improbable that they are. It is a noteworthy fact that the approach of warm weather in this State brings about the formation of resting spores in some diseases much as cold weather does in northern regions, and this may be so in the case of Late Blight.

The damage done by this disease in Florida is somewhat different from that caused in many other districts. The potato crop is usually dug between the 21st of April and the 15th of May and because of the danger of being driven out of the market by more northerly sections, it is usually necessary to dig as early as possible. A yield of fifty barrels per acre is considered very good for the first diggings, but two weeks later the yield in the same field would be seventy or eighty barrels per acre, because of the increase in the size of the tubers. Frequently it is possible to dig slowly and take advantage of this increased yield, but this cannot be done if Late Blight attacks the crop. The potatoes do not increase in size after they are once severely attacked, because the food supply furnished by the tops is cut off entirely. Furthermore there is always the danger of rotting in transit as a consequence of which the grower suffers a direct loss and the reputation of the product for the whole State is injured.

How the disease was introduced. We are safe in saying that the disease is not indigenous in Florida. It has not made its way gradually south, passing from field to field. But there is every evidence that it was introduced in the seed potatoes. These are brought in from New York, Maine, Massachusetts and other States. The last year or two, Late Blight has been extremely prevalent in northern potato regions and much of the seed brought to Florida has been infected as described above and shown in Plate IV, Fig. A. An examination of the seed purchased and used by Mr. C. G. White, of Hastings, Fla., showed that there was at least 5 per cent. of all the potatoes diseased by Late Blight. Many others secured seed similarly diseased, and it is not too much to say that the most of the seed potatoes used in Florida in the last two years at least, contained a certain percentage of diseased tubers.

Methods of Control.

1. If possible, secure seed free from the disease. Get them from a good, reliable grower who uses his spray pump industriously.

2. In preparing the seed for planting, discard all potatoes showing the slightest signs of decay. Some diseased specimens may not be noted, but the majority can be taken out.

3. The disease can be kept in check by spraying thoroughly with Bordeaux mixture. Five or six applications should be given. In Florida, the potatoes are usually planted about January 15th. The plants are well up, and spraying should be commenced about March 12th. As noted above, the crop is dug about the last of April. Between March 12th and April 30th, five or six sprayings should be given. This would be at intervals of ten days.

This was the plan pursued in the experiments carried on with

Mr. C. G. White and the results were thoroughly satisfactory. No blight developed in Mr. White's fields, but others were badly attacked. In several fields where the disease started, it was completely checked by prompt spraying. The following notes from Mr. White's correspondence are of interest:

Feb. 2nd, 1904. "It might be well to note that there was 10 per cent. of rot in the seed at planting." This shows that there had been an increase of 5 per cent. in the amount of rotten seed since the first examination was made, the last of December.

Mar. 24th, 1904. "I have sprayed three times, at a cost of about 64 cents per acre each time. Used 50 gallons solution per acre and this covers well so far."

April 11th, 1904. "The potato tops are so green and thrifty that it hardly seems that we shall be digging next week, but I reckon we shall."

The spraying outfit used in the experiments was an Aspinwall geared sprayer fitted with the Cornell system of nozzles and proved very satisfactory indeed. Four rows were sprayed at one time. The nozzles were arranged so as to drive the spray sidewise into the rows, two nozzles to each row.

4. The stems, leaves, and small or rotten potatoes, left after the crop is harvested, should be gathered and burned.

Early Blight.

(*Alternaria solani* E & M.)

Frequently this disease may be taken for the one just discussed, for at a distance the two are indistinguishable and frequently they are found associated upon the same plant or even upon the same leaf.

Early Blight (the name is applied because it usually appears

earlier in the season than Late Blight) has not been so destructive in Florida as the Late Blight, still a considerable amount of damage is done annually.

The disease is most apparent on the leaves and the tubers are not attacked. On the leaves the diseased areas are small or medium sized, and almost circular in outline, though frequently the spots are confluent, in which case the circular outline may almost disappear. A careful examination of the diseased spots shows them to be marked by concentric rings, a peculiarity not found in the diseased spots caused by Late Blight. Upon these brown areas the dark, many-celled, club-shaped spores are produced. By means of these the disease is spread.

So far as known, no resting spores are formed and the fungus is carried over from one season to another on parts of the diseased plants. It attacks the tomato and a number of allied plants, as well.

In Florida, the fungus (*Altenaria solani*) is a true parasite. Mechanical injury to the leaves by various insects doubtless assist in increasing the virulence of its attacks, but the fungus has the power of attacking the fresh uninjured foliage of the potato.

Every season this disease is responsible for a very considerable amount of injury in the potato fields. When once attacked, the leaves soon lose their power of procuring and preparing food, as a result of which the tubers are much reduced in size and frequently in number. Often the disease appears in conjunction with Late Blight, in which case it is rather difficult to distinguish between the two, but a close inspection reveals the distinction manifested in the foregoing paragraph.

Methods of Control.

1. Spraying as recommended for Late Blight will hold the Early Blight entirely in check.
2. All refuse from the crop (stems and leaves) should be gathered and burned.

Scab.

(*Oospora scabies* Thax.)

This disease is one which is more or less prevalent in Florida, yet, owing to the fact that little stable manure is used in the commercial fields, and because our soils are usually more or less acid or at least neutral, it is by no means so common as in some other potato districts of the country.

The characteristic appearance of the tubers when attacked by this disease, is shown in Plate III, Fig. B. They become covered with rough, scaly spots which may be few in number or so numerous as to almost cover the entire outside of the potato, as in the second specimen from the left hand side as shown in the plate. This scurfy appearance of the potato skin is brought about by the combined effects of the fungus and the attempt of the tuber to withstand its inroads.

If the potatoes are attacked while young the diseased spots increase in depth with the development of the tuber and are quite deep in the grown specimen. If the tubers are nearly developed before being attacked, the spots are quite superficial. In extremely bad cases the potatoes may be furrowed and cracked. As a general rule the diseased areas have their origin in one of the breathing pores found on the potato and the scabby markings are due to the formation of corky tissue.

Scab is usually carried about on the tubers, though it may be present in the soil.

Methods of Control.

1. Treat the tubers with formalin or corrosive sublimate as directed in Bulletin ~~76~~ Florida Experiment Station.

Rhizoctonia Blight.

(*Rhizoctonia* sp.)

This disease is responsible for the rotting of the stems of the potato, for the formation of aerial potatoes (potatoes on the stems as shown in Plate 1), for the rosette development of the tops and the formation of small potatoes which usually accompanies this peculiar formation of the leaves and stems.

This disease is doubtless widely distributed in Florida at the present time. A careful examination was made of the seed potatoes held for sale by dealers in Jacksonville, Fla., last spring with the result that scarcely a lot of seed could be found in which the *Rhizoctonia sclerotia* were not present on some tubers. In the seed used by Mr. White at Hastings and that used as well in our experimental work, fully sixty per cent. of the tubers were thus affected.

The fungus is introduced into the soil on the tubers. Irregularly shaped, more or less elevated patches of fungus threads are formed on the outside of the tubers. These are clearly shown in the frontispiece and in Plate IV. It is frequently quite difficult to make them out, but if the tubers are moistened, by dipping them in water, these fungus patches (sclerotia) stand out in such contrast to the skin of the potato that they are easily seen. If potatoes, thus infested, are planted, the fungus attack the young sprouts as they are shoved out from the eyes.

Mr. White has informed the writer that the disease has been present in the Hastings fields for a number of years past. In 1903

PLATE I



Rosette of Potato Plant Caused by Rhizoctonia.

in some fields, from one-quarter to one-third of the plants were cut off and it is not too much to say that this disease has been one of the most prolific causes of "poor stands" in the potato fields.

The rotting of the potato stems immediately follows the starting of the seed into growth, for the conditions which favor the developments of the potato plant, favor as well the growth of the fungus. The diseased spots (lesions) on the young stems occur just at the tuber and some distance above. It was at first suspected that another fungus might be present, but a critical microscopical examination usually revealed the presence of the fungal threads of *Rhizoctonia*.

As a result of the attacks of the fungus upon the tender tissues of the young stems many of them fail to develop. They wilt, droop and die. Numerous specimens in this stage have been received from different sections of Florida and from Georgia as well. As a result of these attacks large numbers of the growing stems are destroyed. This stage of the disease is most apparent just as the shoots are pushing through the ground.

The stems of many plants are not sufficiently injured to destroy them. Only the outer tissues are affected and the tops still continue to grow. In such cases the downward flow of sap is interfered with. Starch, of which the potato is largely composed, is manufactured in the leaves, is dissolved, passes downward and is stored in the tubers. The attacks of the fungus on the stems, cut off this downward flow, and the formation of small potatoes in the axils of the leaves along the stem, is the result. Such potatoes as do develop underground are very small and unsalable.

Frequently as a result of the attacks of the fungus, the tops of the potatoes develop in a peculiar manner. The leaves are peculiarly twisted, the veins stand out prominently and altogether

PLATE II.



(LOT I.) 75 PER CENT. APPARENTLY GOOD SEED.

25 PER CENT. SCAB.



(LOT II.) 60 PER CENT RHIZOCTONIA.

5 PER CENT. LATE BLIGHT.

35 PER CENT. APPARENTLY GOOD SEED.

Seed Potatoes Used in the Experimental Work.

they have an abnormal appearance. The internodes (spaces on the stem between the leaves) are shortened. Aerial potatoes frequently accompany this abnormal development. See Plate I.

Experiments in Controlling Rhizoctonia.

Experiments in controlling this disease were carried out with Mr. C. G. White, Hastings, Fla. Sixty rows of potatoes, of which it took about twenty to make an acre, were planted for experimental work, approximately three acres in all. The experiment was made in duplicate.

Two kinds of seed were used. The seed containing sixty per cent. of Rhizoctonia affected tubers referred to above and another lot of seed apparently entirely free from disease, but containing at least 25 per cent. of tubers affected by scab.

Outline of the Experiment.

- Plot I. 3 rows treated with corrosive sublimate, just before planting. (Jan. 15.)
- Plot II. 3 rows treated Dec. 30th, with corrosive sublimate.
- Plot III. 3 rows seed treated with formalin and soil also treated with formalin.
- Plot IV. 3 rows seed treated with formalin.
- Plot V. 3 rows untreated affected seed.
- Plot VI. 3 rows clean untreated seed.
- Plot VII. 3 rows with sulphate of copper in the soil at rate of 200 lbs. per acre. Seed treated with formalin.
- Plot VIII. 3 rows slag phosphate used in fertilizer at rate of 1,000 lbs. per acre. Seed treated with formalin.
- Plot IX. 3 rows lime and sulphate of copper in the soil. 1,000 lbs. lime and 200 lbs. sulphate of copper per acre. Seed treated with formalin.

Plot X. 3 rows treated with lime at rate of 2,000 lbs, per acre in the soil. Seed treated with formalin.

The object of the experiment was three-fold, to determine whether the disease on the tubers could be destroyed, to determine whether it was carried over in the soil (the ground had been planted in potatoes the year previous and the disease was present in 1903) and to determine whether anything could be done to prevent its attack on the crop.

RESULTS OF THE EXPERIMENT.

Plot No.	Bushels of Marketable Potatoes.	Bushels of Cull Potatoes.	No. of Hills Showing Rhizoctonia.
1	161.5	20	475
2	199.5	19	496
3	121.5	41.75	361
4	188	21	456
5	173	11	475
6	174	11	418
7	127	9.5	342
8	156.75	19	418
9	158.66	9.5	475
10	174	9.5	285

In order of yield of marketable potatoes, the plots stood as follows: 2, 4, 6 and 10, 5, 1, 9, 8, 7, 3. In order of number of hills of Rhizoctonia, they were as follows (arranged with the lowest first): 10, 7, 3, 6, and 8, 4, 1 and 5 and 9, 2.

The large yield of plot No. 2 is ascribed to the fact that the potatoes used for this plot were exposed to the light and air and the seed was quite green when planted.

Plot No. 10, the freest from Rhizoctonia, was treated with lime and from this it would appear that an alkaline soil condition is not favorable to the development of the disease.

The appearance of so many diseased hills in plot 5 leaves no room to doubt that the disease was present in the soil from a previous infection. It is also obvious that any of the methods tried will not render the crop free from the attacks of the disease, if it be present in the soil.

The occurrence of Bacterial Blight interfered seriously with the results of the work. This accounts for the exceedingly low yield of plot 3. It was worse attacked by Bacterial Blight than any other plot in the field. Too much stress cannot be laid upon the results of this work, so far as treatment goes. But we have eliminated some of the possible means of control, demonstrated that the disease is carried over from year to year and that the methods of control must be directed towards preventing infection of the soil.

Methods of Control.

1. Clean seed should be secured if possible. This is extremely difficult. All tubers should be treated with formalin before planting. Prof. Selby, of Ohio, found this method quite effective. For directions see Bulletin 73 Florida Experiment Station. The cost is about 3 cents per barrel.
2. Lime may be used to advantage.
3. Seed should be exposed to the air and light sufficiently long to develop a strong green color in the tubers. Thus treated, the plants developing from them are increased in vigor.
4. Gather and destroy the remains of the crop.
5. Rotation of crops. Soil badly infested with the disease should not be planted in potatoes. How long it will take to work the disease out of the soil has not been determined, neither do we know how many other crops are attacked.
6. It is probable that a variety of potatoes which will resist the disease may be discovered or originated.

Bacterial Blight.

(*Bacillus Solanacearum*, Smith.)

The Bacterial Blight of the potato, attacking the tomato, egg-

plant and some other solanaceous plants as well, frequently does considerable damage to the crop in Florida.

The disease is characterized by the wilting of a part or the whole of the plant. A single leaf or stem may wilt or if the main stem be the point first attacked, the whole plant droops. Following this wilted condition the plant soon dries up, and becomes denuded of its foliage. The diseased plants are easily picked out.

The disease is caused by a minute vegetable organism which lives and grows in the inner tissues of the plant, being confined to the inner fibrous or woody parts of the stem. If a diseased stem be cut across, the diseased areas in the form of dark spots arranged somewhat in a circle about, and some distance from the center may be readily observed. The germs make their way downward through the stems to the tubers.

In the tubers much the same appearance may be noted. On cutting a diseased tuber, a part or all of the fibrous part will be seen to be dusky black in color. (See Plate IV).

If the tuber be squeezed in the hand minute drops of a creamy substance will be forced out of the diseased spots. This substance contains almost pure cultures of the bacterium causing the disease.

The disease is spread largely through the agency of insects. Potato beetles are not present in the Florida fields, but grasshoppers, leaf-hoppers and other insects perform the work of carrying the disease from infected to uninfected plants.

Methods of Control.

1. Infected seed should not be planted.
2. Since the disease is carried by insects, these should be destroyed as far as possible.
3. In small areas or wherever feasible, the diseased plants should be taken out and destroyed.

In Florida the disease seems to attack those fields which are especially well drained and aerated, worse than those in which less attention has been given to soil drainage. It may be preferable to secure drainage by ridging the hills for planting, rather than by underdrainage.

Acknowledgements.

The writer desires to acknowledge the kindness of Mr. C. G. White, of Hastings, Fla., with whom the experimental work was carried out and whose lively interest and accurate powers of observation contributed much to the success of the work.

H. HAROLD HUME.



Fig. A. Tubers showing *Rhizoctonia*. A clean tuber at the right for comparison.

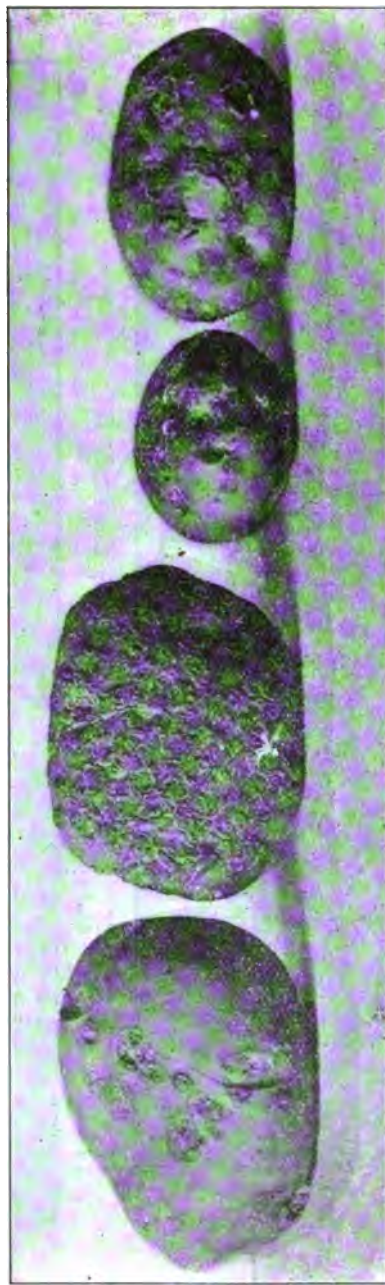
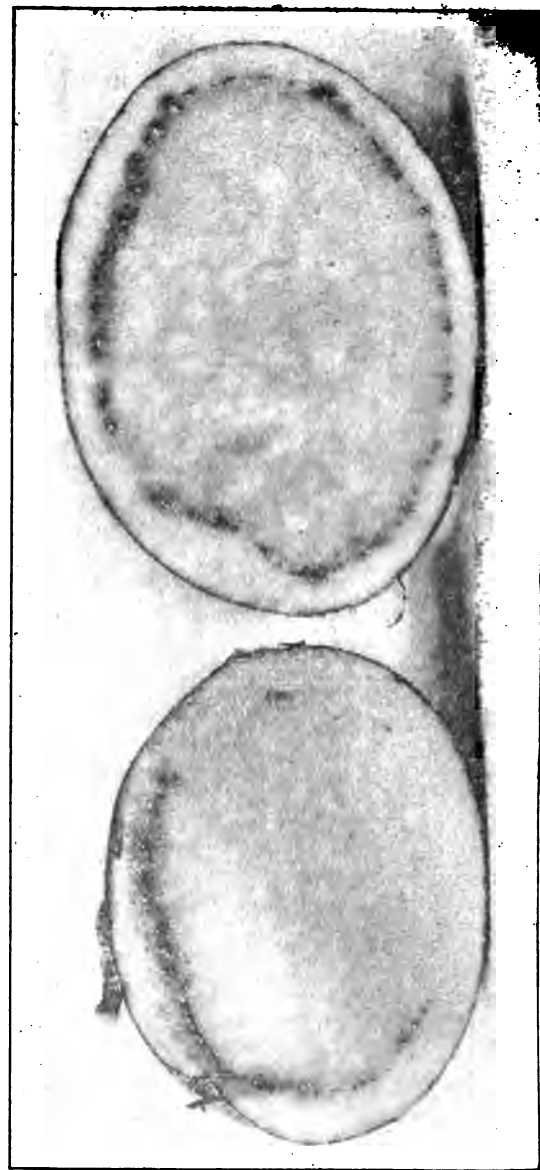


Fig. B. Tubers affected by Scab, Note the roughness of the skin.

PLATE IV.



Fig. A. Tubers affected by Late Blight.



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NOVEMBER, 1904.

**FLORIDA
AGRICULTURAL EXPERIMENT STATION**

Insecticides and Fungicides.



By H. A. GOSSARD and H. HAROLD HUME.

(Recently officers of the Florida Station; now respectively with the Ohio and North Carolina Stations.)

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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Insecticides.

H. A. GOSSARD.

Introductory.

The wide-awake agriculturist has frequent need to refer to manuals of spraying which furnish information concerning insecticides, fungicides and apparatus. "The Spraying of Plants," by E. G. Lodeman, published by The Macmillan Co., New York, gives a history of spraying in both Europe and America. It contains much instructive matter and is a valuable addition to any agricultural library. Weed's "Insects and Insecticides," is also a useful volume for reference. "Smith's Economic Entomology," published by J. B. Lippincott & Co., Philadelphia, devoted to the entire subject of Practical Entomology, is one of the most helpful volumes published.

Of the bulletins published by the United States Department of Agriculture which, if available at all, are furnished free to applicants, the following are named as especially good in one or more particulars: Farmers' Bulletin, No. 127, "Important Insecticides"; Farmers' Bulletin No. 146, "Insecticides and Fungicides"; and Farmers' Bulletin No. 172, "Scale Insects and Mites on Citrus Trees." They may be obtained without cost by applying to the Secretary of Agriculture at Washington or to members of Congress.

Many of the manufacturers of spraying apparatus prepare each year a brief manual containing formulæ for the mixing of the more important sprays, and also furnish reliable information regarding spraying apparatus.

By consulting the following manufacturers of spraying machinery, devices suited to nearly every kind of insecticidal and fungicidal operations may be obtained:

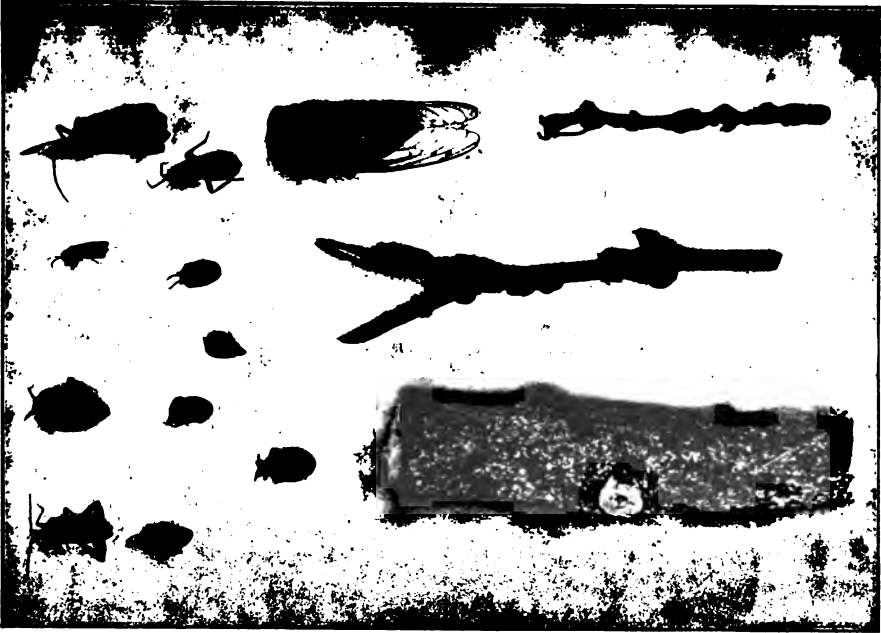
Field Force Pump Co., Elmira, N. Y.; Wm. Stahl, Quincy, Ill.; Gould Mfg. Co., Seneca Falls, N. Y.; "Friend Mfg. Co.," Gasport, N. Y.; Deming Co., Salem, O.; F. E. Myers & Co., Ashland, O.; Spramotor Co., Buffalo, N. Y.; Morrill & Morley, Benton Harbor, Mich.; Niagara Spraying Co., Middleport, N. Y.; Hardie Spray Pump Co., Detroit, Mich.; Leggett & Bro., 301 Pearl St., N. Y.; Thos. Woodason, 451 East Cambria St., Philadelphia, Pa.; Dust Sprayer Mfg. Co., 510 Broadway, Kansas City, Mo.; Dust Sprayer Co., St. Louis, Mo.; Hillis Dust Spray Mfg. Co., McFall, Mo.; E. C. Brown & Co., Rochester, N. Y.; The Pierce-Loop Sprayer Co., Northeast, Pa.; Dayton Supply Co., Dayton, O.

For insecticidal practice, insects are distinguished as those which bite off and chew their food, and those which pierce plant or animal tissues and suck the juice from thence. Of the first class we have familiar examples in the grasshopper, the caterpillar and the beetles; of the second, in the squash bug, plant lice or aphids, mosquitoes, scale insects, etc. The biting insects are destroyed by feeding them stomach poisons with their food; the sucking class, by means of penetrating preparations which kill by contact; and both classes to some extent by subjecting them to the inhalation of poisonous gases, or they are driven off by materials possessing disagreeable qualities and known as repellants. The biting insects leave holes and ragged edges where they have eaten as evidence of the character of their mouth parts, while the sucking ones usually cause the leaves to become minutely spotted or speckled with white, any severe case of puncturing being followed by wilting down and drying up of the leaves.



Biting Insects.

PLATE 1



Sucking Insects.

Internal Poisons.

White arsenic or arsenious acid (As_2O_3) is the active principle in most insect poisons. It must always be chemically combined with some element as lime, lead or copper, that will keep it in suspension in water, never permitting it to go into solution, or it will penetrate the leaf tissues, killing them, causing what is known as burning of the foliage.

1. Arsenic Bran Mash.

White arsenic, 1 lb., or Paris green, 1 lb.; syrup, 2 qts.; bran, 50 to 75 lbs. Thin the syrup with water, then mix well with the other materials and add enough more water to make a wet but not sloppy mash; 2 to 4 lbs. of dissolved sugar may be used instead of the syrup.

For grasshoppers, cut-worms and crickets. Scatter mash where grasshoppers are abundant, and for cut-worms put a teaspoonful near the base of each plant. If on the first night after plowing the field, the bait is scattered and left for two or three days, the cut-worms, having nothing else to feed on, will come to the surface, devour it and be practically exterminated before the crop is planted. Scattered upon cabbages it is good to destroy cabbage worms. Wire worms may be poisoned to some extent by putting Paris green or white arsenic on slices of Irish potato or some similar vegetable and using for a bait.

2. Criddle Mixture.

The most successful remedy yet tried in some of the Canadian provinces and Northwestern States for young grasshoppers—not so effective against the old ones—is the Criddle mixture:

1 part, by measure, of Paris green; 120 parts, by measure, of horse droppings, preferably fresh; 1 lb. of salt should be added

when the droppings are not fresh. First mix the Paris green into a paste with water, then add more water and stir with the droppings until a homogeneous mass, damp, but not dripping when ladled, is obtained. If salt is used, dissolve in water before adding. Said to be much more effective if spread in hot, sunny weather.

3. Arsenite of Lime.

Cheapest of all the arsenical sprays; equal to Paris green in efficiency; cannot be readily adulterated; used as a spray for all biting insects. When properly made, will not burn foliage at ordinary strength; remains in suspension better than Paris green or London purple and combines readily with Bordeaux mixture, furnishing an effective and cheap combination of insecticide and fungicide.

White arsenic	1 lb.
Lime	2 lbs.
Water	3 gals.

Boil together for full 40 minutes after the boiling point is reached. As a precaution against danger of burning, slake an additional pound of lime, add to it 3 or 4 gallons of water and pour it into the arsenic and lime mixture obtained from the above formula. Before diluting, strain through a coarse cloth or sieve to take out the lumps that would otherwise clog the nozzle. Dilute to 250 gallons before applying to ordinary foliage. Potatoes will stand a dilution of from 150 to 200 gallons, while peaches and cucurbits should not be sprayed with a dilution of less than 300 to 400 gallons. Perhaps a safer formula for tender vegetation is as follows, but it is nearly twice as expensive:

White arsenic	2 lbs.
Sal. soda	.8 lbs.
Rain water	2 gals.

Boil these ingredients for 15 minutes after the boiling point

is reached. This should be labelled "poison" and kept as a stock solution. This can be kept for use as needed up to a six months' limit, but is risky if kept longer because of chemical disintegration by which soluble arsenic is freed. When ready to spray, slake 2 lbs. of lime, dilute with two gallons of water, strain and add to it one pint of the stock solution. Stir well and dilute to 40 gallons, again stirring thoroughly. Double this strength may be used on potatoes without injury, but 2 additional lbs. of lime should be used with each additional pint of stock solution used. Should the arsenic-soda solution be used without the lime, disastrous results will follow to foliage. The jugs and containers in which the arsenicals referred to under this heading, "Arsenite of Lime," are boiled and kept, should never be used for other purposes.

4. Paris Green.

When not adulterated, a good insecticide. Good Paris green should contain between 55 per cent. and 60 per cent. of arsenious acid (58.65 per cent. being the theoretical standard), of which not more than 4 per cent., or at most 5 per cent., should be free, otherwise foliage will be scorched. The only way to determine the percentage of free acid is to have an analysis made by a competent chemist. The excess, often found, indicates that the manufacturers have an inferior article which they try to bring up to grade by the addition of white arsenic. Gypsum is often used as an adulterant to increase the weight. To test for gypsum, take 1-4 teaspoonful and add to a drinking glass of water; stir well and add 6 tablespoonfuls of ammonia stirring for five minutes. Since pure Paris green is soluble in ammonia, if sample is correct, no undissolved residue will remain in the water.

Paris green	1 lb.
Lump lime	2 lbs.
Water	160 to 200 gals.

The poison should first be put into enough water to form a paste and then must be added to one or two lbs. of slaking or freshly slaked lime which neutralizes the free arsenic. An excess of lime will do no harm. For sensitive foliage, such as peach and bean, dilute to 200 gallons; for hardier plants, to 160 gallons. Potatoes will stand 1 lb. to 80 gallons; while for toma toes and conifers it is perhaps best not to use it at all, but to substitute arsenate of lead. Paris green should be very finely crystallized and must be kept agitated while the spray is being applied to prevent the poison from settling to the bottom. The finer the poison the more quickly it will act when subjected to the digestive action of the insect. When possible, select a cool afternoon, toward evening, to do the spraying, as warm water has great capacity for putting arsenic into solution. Paris green is very conveniently applied with Bordeaux mixture, the Bordeaux instead of water, in the same quantity, being the dilutant; the burning qualities of the insecticide are completely neutralized by the Bordeaux.

Applied in the dry way, the powder is best diluted with about 20 times its own weight of flour or lime. Flour is better than lime as a carrier, since insects are not repelled from it as from lime, but it costs more. The dust may be shaken from a cheese cloth sack or applied with a powder gun.

5. Resin-Lime Paris Green Mixture.

In spraying with the arsenites, other than arsenate of lead, upon smooth-leaved plants, it is difficult to make the poison adhere.

By using the following preparation, a persistent, adhesive spray is obtained:

Pulverized resin	5 lbs.
Concentrated lye	1 lb.
Fish or other animal oil	1 pint.
Water	5 gals.

Heat the oil and resin with a gallon of water until the resin is softened; add the lye, stir well, and put in the remaining 4 gallons of water, boiling for two hours or longer; add enough water to make 5 full gallons and keep as a stock solution.

For use take of this resin stock solution, 1 gallon; whitewash, or milk of lime, 3 gallons; Paris green, 1-4 lb.; water, 16 gallons.

Stir the Paris green into the whitewash while it is slaking or after it is slaked, then add to the water, then pour in the resin solution. This is desirable for use on cabbages before they begin to head, and on cauliflower before the flower is exposed. At later stages of growth, for cabbage worms, use mixture of pyrethrum and flour.

6. Green Arsenoid.

Chemically, this is arsenite of copper, and, physically, is amorphous or uncrystallized Paris green. It is cheaper than Paris green and stays in suspension far better, but contains almost double the amount of soluble arsenic, hence, to be safely used, *must always* be combined with a *sufficient* quantity of lime. Many prefer it before Paris green.

Green arsenoid	1 lb.
Fresh lump lime	3 lbs.
Water	160 to 200 gals.

Safe and desirable to use with Bordeaux.

7. Some Commercial Arsenicals.

According to the California Station, Pink arsenoid is arsenite of lead; contains less free soluble arsenic than Green arsenoid, but has a smaller total percentage of arsenic and is a safe and cheap preparation. White arsenoid is barium arsenite; contains a dangerously high percentage of free arsenious oxide, all of which is more or less soluble. It is a substance that is dangerous to foliage. Gray arsenoid is a mixture of the calcium and copper arsenites and contains too much soluble arsenic to be entirely safe, but with lime added as a neutralizing agent, it is perhaps to be preferred before London purple. Laurel green is a mixture of inert matter with a relatively small proportion of arsenite of copper, dear at any price. Paragrene is objectionable because of an excess of free soluble arsenic.

8. London Purple.

Chemically, arsenite of calcium, but very variable in percentage of free arsenic present. Remains well in suspension and can be used with Bordeaux. Must be handled with great care and at best is somewhat unreliable. Should be neutralized with a sufficiency of lime as in case of Paris green. Use 1 lb. of London purple to 160 or 200 gallons of water. Its use is not recommended.

9. Arsenate of Lead.

On sensitive foliage, the safest of all arsenicals. Contains no free arsenic, hence does not burn the tenderest plants. It is also very persistent in remaining upon foliage for long periods of time, even when drenched by hard rains. If applied on a fair day, so it has time to dry on the foliage, it will adhere for months. Needs some stirring while being applied, but remains in suspension better than any other of the arsenical poisons. Especially useful in the garden.

Acetate of lead	24 oz.
Arsenate of soda	10. oz.
Water	3 gals.

The acetate of lead should be guaranteed to contain about 60 per cent. of available lead oxide, and the arsenate of soda should be 6 to 8 per cent. pure, with chlorine present not to exceed 2 or 3 per cent. Dissolve the 24 ozs. acetate of lead in two gallons of warm water in a wooden pail, and in a separate pail of wood dissolve the 10 ozs. arsenate of soda in 1 gallon of hot water and when the two solutions are fully dissolved, pour together into the spray tank containing 100 gallons of water. The fine, whitish, precipitate formed is arsenate of lead, which will remain in suspension a dozen times as long as Paris green. A mixture of several times this strength can be used without any danger whatever to foliage.

Some commercial brands of arsenate of lead are upon the market. Bowker's Disparene, made by the Bowker Insecticide Co., of New York; Swift's arsenate of lead, prepared by the Merrimac Chemical Co., Boston Mass.; and the Adler Co.'s goods are all safe and reliable compounds. They do not remain in suspension so well as the home-made mixtures and for extensive work are, perhaps, less desirable. They are very convenient, however, for use in a small garden where a quick, ready-made, perfectly safe preparation is wanted. The home-made mixture should not be kept as a stock solution, or it will lose much of its power to remain well in suspension.

10. Arsenite of Lead.

Sodium arsenite	12 oz.
Lead acetate	4 lbs.

Dissolve the lead acetate in two gallons of warm water, likewise the sodium arsenite in one gallon of warm water. Pour the

two solutions together into a spray tank containing from 50 to 150 gallons of water, according to the strength desired and a compound will be obtained as harmless to foliage as the arsenate of lead and also capable of remaining in suspension longer than any other arsenical.

11. Borax and Phosphorus.

Put together in a mortar equal parts of borax and chocolate and crush to a fine powder. Scatter where cock-roaches will find it. If a mortar is not at hand wrap the materials in a cloth and beat well with a hammer until each particle of chocolate has a particle of borax adhering to it. Or, spread powdered borax on bread, slices of sweet potato, or banana peelings, and put in places frequented by roaches. Better than borax for roaches is a phosphorus paste. This may be spread upon bread or bits of paper and put in the way of the insects. Phosphorus paste is sold on the market under various names, as Electric Paste, etc.

13. White Hellebore.

Occupies an intermediate position between stomach poisons and contact insecticides; loses its poisonous properties after being exposed to the air for a few days and therefore can sometimes be used to advantage upon fruits or plants that are soon to be eaten. Must be kept in tight receptacles and should not be kept too long before being used. Is especially useful against slugs, or the larvae of saw flies. Apply as a spray in the evening (many worms feed at night), one ounce in three gallons of water, or as a powder with a blow-gun or from a cheese-cloth sack.

Cyanide of Potassium.

Acts both as a poison and as an inhalant. If this substance be powdered and thrown into the nests of ants which have been

somewhat disturbed by a little stirring most of the colony will destroy themselves in attempting to remove the obnoxious stuff and the remainder will move elsewhere. Can sometimes be used near the roots of plants where bi-sulphide of carbon would be dangerous. This is a deadly poison and poultry or anything else picking up and swallowing particles of it will be killed.

Contact Insecticides.

14. Whale Oil Soap.

For safety, efficiency and general range of usefulness whale oil soap is hardly second to any contact insecticide. It is useful against all forms of plant lice and scale insects. Upon the market are found hard whale oil soaps and similar soft soaps. The hard soaps have caustic soda for their alkaline constituent while caustic potash furnishes the base for the soft soaps. Potash forms a stronger chemical union with fatty acids than caustic soda, and hence potassium hydroxide, or lye is less apt to separate out from a potash spray than is a sodium hydroxide from a soda soap spray; there is, therefore, less likelihood of damage to plant tissues from the potash soaps. Potash soaps seem to give much better results on orange trees, especially, than soda soaps. Such soaps should not contain over 30 per cent. of water. Potash is also a fertilizer, and possibly acts in some degree as a stimulant to plants when applied even in such small quantity as is contained in a soap spray. The potash soaps go into solution in water much more readily than the soda soaps unless the latter are kept at a high temperature. When possible use rain water for dilution, or, if hard water must be used, first "break" it with lye, otherwise a stringy, lime-stearin precipitate will form, interfering materially with satisfactory

work. Among Florida horticulturists, Leggett's Anchor soap has long been in favor as a representative of the hard soaps, and Good's Potash soap, especially the No. 3, is liked by the orange growers. For soft-bodied insects, such as plant lice, use one pound of any good soap in six or seven gallons of water; for scale insects, white fly, etc., on orange, peach and hardwood trees, use one pound in from two to four gallons of water. For Florida conditions one lb. to three gallons is usually strong enough for scales, unless it be upon the trunks and larger limbs. Use weaker solutions in summer. Most scale insects and eggs of plant lice upon deciduous plants are to be found in greatest numbers in winter near the points where new growth will start in the spring; hence, liberal pruning of these is advised before the use of any contact insecticide.

The following is a formula given by Lodeman for making a whale oil soap:

True potash lye	1 lb.
Fish oil	3 pts.
Rain water	3 gals.

Dissolve the lye in boiling water, then add the oil and boil for at least two hours longer. When boiling is finished, there should be two gallons of soap; if necessary, add water to make exactly two gallons. For insects, such as plant lice, use this soap at the rate of 1 lb. in 9 or 10 gallons of water; for scale insects, one lb in five to six gallons of water.

15. Other Soaps. Thrip juice.

Any ordinary laundry soap is useful against soft-bodied insects, such as plant lice, and some correspondents report satisfactory success in keeping scales from orange trees by using on

them each week the soapsuds derived from the family laundry. Fir-tree oil soap possesses twice the killing power of ordinary whale oil soap, when diluted to the same degree.

Hammond's Thrip Juice, made by Benjamin Hammond, at Fish-kill-on-Hudson, N. Y., is seemingly a very concentrated pot-ash-tar soap and is used quite extensively by some of our best orange growers against young scale; sulphur solutions readily combine with it, giving an insecticide effective against the various mites as well as young scale.

16. Kerosene Emulsion.

A very penetrating insecticide—one of the most efficient against all sucking insects.

Whale oil soap, or Hard soap (chipped), 1-2 lb.

Water1 gal.

Kerosene2 gals.

Whale oil soap is to be preferred but ordinary laundry soap may be used. Dissolve in one gallon of boiling water and while soap solution is boiling hot, pour into it, away from the fire, two gallons of kerosene. Commence agitation immediately, with a force pump, pumping the liquid back into itself until a thick, creamy mass is obtained. If the emulsion does not form within 10 or 15 minutes the whole may be reheated to the boiling point over a fire out-of-doors. The time necessary for emulsifying depends upon the quantity of mixture made, and if the proportions given are multiplied several times, the period of agitation must be continued longer. No free oil should appear on the surface when the mixture is completed.

Soft, clean water should be used from which all dirt particles have been removed otherwise they will become centers for the collection of free oil. If only hard water is available it should be

“broken” with lye before being used, or what is perhaps better, an emulsion may be made with milk. Dilute the emulsion obtained from the above formula with 27 gallons of water, or nine parts of water to one part of the emulsion for scale insects; for plant lice it may be diluted twice as much. If the emulsion is well made it can be kept for a long time as a stock preparation in closed jars. For tender plants dilution should be one part of the emulsion to 15 or 20 of water.

Kerosene sprays of any description should not be allowed to collect about the base of the trees or in the crowns of the plants to which they are applied. It is sometimes best to bank the trees with earth before spraying and should the earth become saturated with kerosene remove it from contact with the tree within an hour or two after the application is made.

Bright, sunshiny, breezy days are to be preferred for making kerosene applications so the volatile oils will evaporate at once. In our humid climate, even a much diluted emulsion, if used on a cloudy day at the beginning of a cloudy week, is liable to cause disastrous results, especially to tender vegetation and citrus trees. Use a fine Vermorel nozzle in making kerosene applications.

Kerosene emulsion is an excellent remedy for lice upon live stock, used at the rate of 1 pint of emulsion to 12 or 15 parts of water. The mixture may be applied with a spray pump, and rubbed into the hair of the animals with the fingers or a brush. It is usually best to make two or three applications two or three weeks apart, though one thorough treatment will often suffice.

17. Kerosene-Milk Emulsion.

Kerosene	2 gals.
Milk, sour	1 gal.

Pour together and churn by means of a pump, as in case of

soap emulsions. If a thick butter does not appear after five minutes' churning, add a little vinegar and churn again. If sweet milk is used, the vinegar *must* be added. Milk emulsion ferments after a short time and therefore cannot be kept as a stock solution. It is usually recommended where rainwater is not procurable for making soap emulsion or where small quantities of spray are desired.

18. Mechanical Water Mixtures of Kerosene and Petroleum.

Of the kero-water pumps, designed to effect a given dilution of oil with water at the time of application, the Gould Kerowater pumps and the Spramotor pumps are the best; in fact, are about the only ones that can be recommended, and even these must be often tested while in use to ascertain if the actual percentage of oil being thrown tallies with the setting of the gauge. This is done by pumping a small quantity of the liquid into a graduated glass tube and waiting for the oil and water to separate. When set at 10 per cent. or 15 per cent. these machines are often found to be throwing from 20 to 30 per cent. of oil. They are chiefly useful in fighting San Jose and related scales.

Crude petroleum having a specific gravity of from 43 to 45 degrees on the Beaume oil scale when diluted with from 75 to 80 per cent. of water is excellent for scale insects, if applied during the winter months, while the trees are dormant and devoid of leaves. Crude petroleum is to be preferred before kerosene for winter applications, because of the heavy, non-volatile oils which persist upon the bark for many weeks, killing such young scales as come in contact with it, and preventing any of them from making a set upon the bark for months after the application is made. Crude petroleum must not be used on trees in leaf, or upon ever-green trees. For summer applications against scale, a 15 per cent.

mechanical mixture of refined kerosene with 85 per cent. of water is excellent. A few correspondents report the satisfactory use of kerowater pumps in orange groves, but, because of their unreliability in mixing a definite percentage of oil great caution should be observed in using them in this way. The regular kerosene emulsion is much safer, for anyone not an expert, to use upon any tree or plant in leaf. Use all precautions given in the paragraph upon kerosene emulsion. Always apply with a fine Vermorel nozzle.

19. Resin Wash.

1. Resin, pulverized20 lbs.
 Caustic soda, granulated, 98 per cent. 4 1-4 lbs.
 Fish oil 3 pts.
 Water, for final bulk150 gals.

A somewhat cheaper formula is the following:

2. Resin, pulverized20 lbs.
 Crude caustic soda, 78 per cent.4 lbs.
 Fish oil2 1-2 pts.
 Water for final bulk 100 gals. to 150 gals.

Ordinary commercial resin, such as is bought by the barrel in Florida, is satisfactory, and the 78 per cent. caustic soda is of the quality used in soap factories. The crude soda comes in drums of from 112 to 200 lbs. each.

Another formula which has given good satisfaction to some growers because of the convenience of quickly obtaining the materials without ordering them from a distance, and of keeping the soda indefinitely without special precautions is as follows:

- Resin, pulverized 20 lbs.
 Fish oil 3 1-2 pts.
 Caustic soda (Star Ball potash, pulverized) 7lbs.
 Water for final bulk 100 gals.

As a smothering wash, the first formula is probably equal to the second, or third, but its contact effects are less satisfactory. If the wash is to be used in summer, the dilution given in the first formula is about right, but for winter use better results are secured by diluting to 100 gals. instead of 150.

The details of preparation are the same no matter which formula is used. Procure a large iron kettle, a hog-scalding vat is excellent, and another smaller kettle for hot water. If a large kettle of from 25 to 40 gallons capacity is unavailable, a number of smaller ones can be used, the materials being divided between them as they are weighed out and measured. Heat in the large kettle 13 or 14 gallons of water, having previously placed in the bottom the materials given in one of the formulae. If the water is hot before the materials are put in, add the resin and fish oil first and then the soda, in small lots, to prevent a sudden boiling over. Boiling is best continued for two or three hours over a hot, but not too brisk fire. One hours' boiling or less will give a mixture which can be used, but results will not be as satisfactory as when the wash is thoroughly cooked. Whenever there is a tendency for the liquid to boil over subsidence will quickly occur if a pint or more of water from the water kettle which is kept warm but not boiling, is added. Never add cold water while the wash is cooking, if you desire results that are certain. Increase the quantity of solution by gradual additions of warm water until a stock solution of 30 gallons is obtained. For use, this is to be diluted to 150 gallons in case of the first formula, to 100 gallons with the second, and 100 gallons with the third. The stock solution may be kept for a time and used as desired, but the wash is best used as fast as made. Any sediment or settling in the stock solution indicates that cooking was incomplete and must be repeated.

Where a steam pump is possessed or a head of steam is available, a set of barrels may be arranged with steam pipes leading through them and resin wash can be prepared rapidly and in large quantity by boiling with steam. The stock solution should be strained before diluting it to remove any particles or trash that would clog the pump nozzle. Apply with a coarse nozzle.

Resin wash is useful on all scale insects, plant lice, etc., but is especially used against the soft scales, or Lecaniums, and White Fly. Three or four applications of this spray to citrus trees within so short a period as three or four months give the trees a severe shock. Two thorough applications during the winter with possibly an additional one in the summer, are all the trees should be expected to stand, and this treatment should not extend through a continuous period of several years; if continuous treatment must be given make part of the sprayings with a high-grade potash soap. If cooking is incomplete the resin wash will be exceptionally injurious and if applied to young fruit under three months old, results are sometimes disastrous. It is best not to use this wash at all on trees in bloom or on those carrying young fruit.

20. Lime-Salt-Sulphur Wash.

Has long been the favorite spray for scale insects on deciduous trees in California, and is now preferred throughout the country as a winter application for all kinds of scales on dormant deciduous trees.

Profs. Alwood and Phillips, of Virginia, furnish the following directions for its preparation (Bulletin 141, Va. Exp. Sta.):

Lime, unslaked	30 lbs.
Flowers of sulphur	30 lbs.
Salt	10 lbs.
Water	100 gals.

"When cooked and diluted, it should test 1.052 to 1.054 on the hydrometer, or about 7 per cent. on the ordinary Beaume acid spindle.

"Proceed as follows to make the wash for small orchard work: Put 4 to 5 gallons of hot water in an iron kettle (20 gallon capacity), add 15 lbs. of sulphur and mix briskly with lime, adding boiling water as needed to bring the entire mass into a thick paste. Work the mass into a perfectly homogeneous paste, then add water enough to make 10 or 12 gallons, and boil for 30 to 40 minutes. It is better to add hot water, as the cooking will thus proceed more rapidly, but if cold water is used, the resulting wash will be the same. Add the salt, 5 lbs., when the paste is diluted. When the wash is cooked, strain and dilute to 50 gallons. This will be best accomplished by pouring it into the barrel already partly filled with water. Hot or cold water may be used, at the convenience of the operator, as there will be no marked difference in the result.

"The quantity sufficient for 100 gallons of wash may be cooked in a 25-gallon kettle, but this is rather concentrated and needs attention. In whatever manner the wash is cooked, it should be stirred occasionally. With two kettles for cooking, mounted on arches or tripods, one man with convenient water supply, can readily make 100 to 150 gallons wash per hour. It is necessary for rapid work to have one large kettle solely for use as a supply of hot water. One needs a stout stirrer for each kettle, used to cook the wash in, and several long-handled sheet-iron dippers, which hold about one gallon each for use in handling the preparation. The cost of the ingredients to make the lime-sulphur wash by the above formula, is about 1 cent per gallon, which renders its abundant use on plants very cheap in comparison with soap or the kerosene washes.

"It is very important to strain the wash as it is run into the spray tanks. The pumps will better resist corrosion by this wash if they are made of iron rather than of brass. Copper machinery cannot be used at all with this wash. The pumps and fittings, of whatever material, should always be washed with clean water after each day's use."

If trees are cut back severely they can be treated with a certainty not possible otherwise. It is difficult indeed to spray a bushy-topped tree, 5 to 7 years old, so as to coat all the twigs, and large trees are proportionally more difficult to treat. Cut-back trees can be treated by hand-mopping or with spray machinery. A rag mop or heavy paint or whitewash brush may be used.

This wash must never be used upon trees in leaf, nor even during the winter season until they have become dormant. The first spraying should not be done until after the middle of December and the second one is best made just before the tree starts into growth in the spring. The spring application will remain upon the trees and prevent the young scales from setting before late summer. This wash is very caustic to the touch and the operator should provide himself with rubber gloves. Horses exposed to the spray should be blanketed.

21. Lime-Sulphur-Soda Wash.

The soda in this formula is designed to boil the sulphur and thus save time. The cost of materials is greater than when the preceding formula is used, but this is offset, in a measure, by the saving in time.

Lime, unslaked	30 lbs.
Flowers of sulphur	15 lbs.
Caustic soda	4 to 6 lbs.
Water,	50 gallons.

While the 20 lbs. of lime is being slaked with water, stir in one-half of the sulphur. Add the remainder of the lime and as it slakes stir in the remainder of the sulphur, adding more water as needed. As soon as boiling ceases, add one-third the caustic soda and before the boiling it causes is past, add another one-third of the caustic soda. The proper color for the finished wash is a brick red, and soda should now be added in small lots until the correct color appears. From 4 to 6 lbs. will usually bring the desired color, but if the lye is weak, it may be necessary to use more than this. Warm water will give a better mixture than if cold is used. This formula has the same range of usefulness as the preceding one, though it is possibly not quite equal to it in effectiveness. The directions given with the lime-salt-sulphur wash apply here.

22. Bisulphide of Lime.

Lump lime, unslaked	5 lbs.
Flowers of sulphur	5 lbs.
Water	4 gals.

Boil all of these ingredients together until they combine, forming a brownish liquid. This is to be diluted to 100 gallons for use. Use for six-spotted mite, rust-mite of the orange, and red spider; quite effective against these insects, but is also a fungicide, destroying the diseases that keep scale insects in check; hence, when used in an orange grove, excessive multiplication of scale insects frequently follows. Experiences with this wash seem contradictory, suggesting a possibility that the particular developmental condition of the fungus at the time of making the application needs to be considered. When used upon orange, follow in two or three weeks with some penetrating insecticide such as whale oil scap, or Thrip Juice. It is usually better to combine sulphur

with a soap or Thrip Juice spray for use against mites, red spider and scale at the same time. Not very effective against the purple mite; most valuable for red spider (*T. bimaculatus*) on garden plants.

23. Soda-Sulphur Spray.

Caustic soda (98 per cent.)	10 lbs.
Flowers of sulphur	20 lbs.
Water	20 gals.

Mix the sulphur to a paste, not sloppy, with cold water in a barrel; add to this wet sulphur 10 lbs. of caustic soda, and as it boils, add gradually 20 gallons of water to prevent burning, not adding enough at any time to drown the boiling. This is the stock solution; when ready to spray, put 40 gallons of water in another barrel and stir in one-half gallon of the stock solution from which all sediment has been removed by straining. Used against purple mite, six-spotted mite and rust mite; for purple mite, young scale and the newly hatched larvae of white fly, use at the rate of one gallon of stock solution to 50 gallons of spray.

24. Whale-Oil-Soap-Sulphur Spray.

The difficulty of killing purple mite with the ordinary sulphur solutions and the tendency of these to act as fungicides, thereby removing the natural checks upon scale increase, has led to the use of combinations that will destroy both mites and scales at the same time. Many growers obtain excellent results against rust mite, six-spotted mite, purple mite, scale insects and white fly by combining sulphur and soap spray, or sulphur and Hammond's Thrip Juice. The combination is sometimes made by first mixing the sulphur into a paste with water and then adding to the spray tank at the rate of one or two lbs. to 50 gallons of soap

spray, but the more satisfactory method and the one commonly used, is to make a soda-sulphur solution, according to the preceding formula, and then add one-half gallon of the stock solution to 40 gallons of soap or Thrip Juice spray. Especially useful to orange growers.

25. *Pyrethrum*, Buhach, Persian or Dalmation Insect Powder.

Kept at all drug stores and is derived from the pulverized blossoms of the *Pyrethrum* plant. Acts on insects through their breathing pores as a kind of narcotic, and is not poisonous to man or to the higher animals. Useful to scatter about for driving away roaches, fleas, flies, etc. It may be mixed with an equal quantity of flour and, if kept corked up in a bottle over night, all parts of the mixture will be effective. Good to use for cabbage worms on headed cabbages, and on fruits which are so nearly matured that the use of arsenicals is undesirable. If the air of a closed room be thoroughly filled with the dust, blown from a powder gun, the flies and mosquitoes will fall to the floor, and may be then swept up and burned. A decoction is sometimes made by boiling one ounce in two gallons of water for ten minutes, this being used as a spray. The dry powder may be sifted between the sheets of beds, suspected to contain bed-bugs, and the sleeper will be but little disturbed. If the powder is moistened and molded into small cones which are then dried in the oven, a cone may be lighted at the apex in the evening and will smoulder slowly, filling the air with smoke and stupefying or killing all mosquitoes in the room, if air currents are not too brisk. Two or three cones are sufficient for an evening. Only fresh *Pyrethrum* can be relied upon.

26. Tobacco.

Tobacco dust, mixed with other fertilizer, is very generally used by pineapple growers for the control of mealy bugs. When used as a top dressing for soils in cucumber and melon patches it has a perceptible effect in interfering with the multiplication of plant lice. It is reported to be efficient for driving "wood-lice" (white ants) from about the roots of trees.

Tobacco decoction is made by boiling one lb. of stems or of dust in one or two gallons of water until a dark brown liquid is obtained. When boiling is finished, add water to make two or three gallons of solution; the efficiency of the spray will be increased by adding one lb. of whale oil soap to every fifty gallons of decoction. If the dust is used, strain out the sand particles to prevent clogging of the pump nozzle. The solution will not harm the tenderest foliage, and is effective against plant lice. "Rose-leaf" insecticide, an extract of tobacco prepared by the Kentucky Tobacco Product Co., Louisville, Ky., is very concentrated and a better decoction than is usually obtained by ordinary boiling.

27. Dust Spraying.

Within the past two or three years some of our largest growers of oranges have used the dust sprayers for distributing sulphur for rust mite. The Cyclone and the Jumbo machines are the ones chiefly used for this purpose. Other dusting machines are made by the Hillis Dust Spray Co., McFall, Mo., while the "Whirlwind" is made by J. J. Kiser, Stanberry, Mo. The mixtures applied are generally one-half lime dust and one-half flowers of sulphur, but sometimes 1-3 lime dust, 1-3 tobacco dust and 1-3 flowers of sulphur are used. Dry Bordeaux is also spread with these machines. The comparative rapidity of the work, because of no water hav-

ing to be hauled about, is the great item in favor of the dust sprayer. Where dusting has been done regularly for mites, with no spraying at all for other insects, the application has in several instances acted as a fungicide, and the very life of the trees was threatened because of the onslaughts of scales, no longer checked by the ever-present diseases that destroy them. It should never be forgotten that materials which, in a dry climate, are recommended as being insecticides and which are such under dry conditions, may, in Florida, become great promoters of insect multiplication. Where dusting is the main practice it is best to give an occasional treatment with soap-sulphur solution to correct the evils sometimes entailed by dry dusting.

Gases Used in Fumigation.

28. Bisulphide of Carbon.

A volatile liquid, whose fumes are heavier than air. When mixed with air the fumes are very explosive, and no fire of any kind should be brought near them. For fumigating a building containing growing plants, not more than one pint to 1,000 cubic feet of space should be used. To destroy weevils in grain in tight bins, use about one lb. to the ton of grain, or the liquid can be poured directly on the grain. If bins are somewhat open, cover with a blanket. Fumigate for 24 to 30 hours, after which the bins should be thoroughly aired. No live stock should be left in a building which is being fumigated.

Ants' nests may be destroyed by pouring the liquid into holes made by thrusting a sharpened stick into the top of the nest to the depth of 10 or 12 inches. Close the holes and cover for an hour with a wet blanket. Sometimes the holes are made to a greater

depth and the operator, standing at a considerable distance, lights the gas with a taper fastened to the end of a pole. The explosion drives the gas into the furthestmost galleries of the ants.

29. Hydrocyanic Acid Gas.

For a full description of the methods of using this gas reference should be made to Prof. W. G. Johnson's "Fumigation Methods," published by Orange Judd Co., New York. The gas is chiefly used for destroying scale insects on citrus trees, but is useful in fumigating rooms and buildings for the purpose of destroying vermin, mosquitoes, etc., as well as for cleansing nursery stock suspected of harboring undiscovered scales. The gas is a deadly poison to all animal life and must be used very carefully by the operator.

For dormant, deciduous nursery trees, uprooted and packed in fumigating house, the following formula is used:

For each 100 cubic feet of space enclosed—

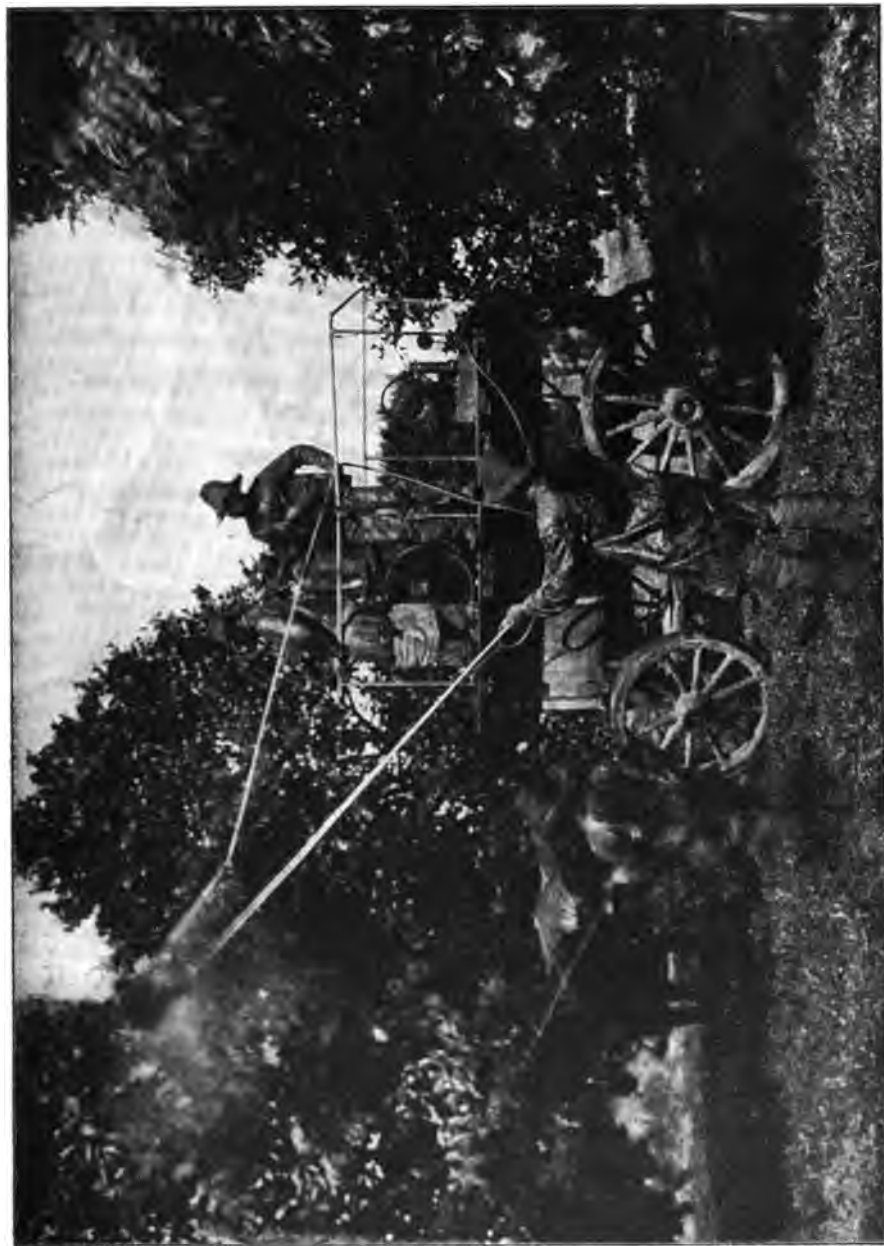
Cyanide of Potassium (98 per cent.)	... 1 oz.
Sulphuric acid	 1 liquid oz.
Water	 2 liquid ozs.

Place the water in an earthenware or wooden receptacle high enough to prevent splashing out of the chemicals when in action; pour in the acid, and when everything is ready, drop in the cyanide of potassium, close the door and keep it closed for at least 40 minutes. Thoroughly ventilate the room before entering. Greenhouses may be fumigated with the above formula for every 350 cubic feet of space.

Orange trees under tents may be treated as given in the following table, prepared by the Horticultural Commissioners of Riverside County, California:

Height of Tree	Diameter of Tree	Water	Cyanide C. P. (98 Per Cent.)	Sulphuric Acid (66 Per Cent.)
Feet	Feet	Ozs.	Ozs.	Ozs.
6	4	2	1	1
8	6	3	1½	1½
10	8	5	2½	2½
12	14	11	5	5½
16	16	17	8	9
20	16-20	22	10	12
20-24	18-22	30	14	16
24-30	20-28	34	16	18
30-36	25-30	52	24	28

The cost of fumigating trees, labor included, and not considering the cost nor wear on the tents, is about equal to the cost of giving the trees three sprayings with resin wash.



**Power Sprayer. Orange Grove of Manatee Lemon Company.
PLATE II**

Fungous Diseases and Their Control.

H. HAROLD HUME.

Diseased conditions in plants may be due to a number of different causes. They may be the result of untoward conditions of soil or climate. They may be brought about by physiological disturbances within the plant or they may be caused by the attacks of parasitic fungi. For the present we shall confine our attention to that class of diseases caused by the attacks of fungous enemies.

A fungus (plural fungi) is a plant possessed of different parts or organs, corresponding in some measure to the parts of ordinary plants. The part of the fungus which fills the purpose of the root system in higher plants is termed the mycelium. The part of the fungus corresponding to the seed is the spore. Leaves there are none, and fungi never possess chlorophyll, the green coloring matter of higher plants. The stem parts upon which the spores are frequently borne are known by a number of different names, such as conidiophore, sporophore, etc. Sometimes the spores are borne inside conceptacles of different kinds, sizes and shapes.

The mycelium, in those fungi parasitic upon plants, lives and grows in some part of the plant attacked. It makes its way through or between the cells of the plant and absorbs its foods from them. After vegetating for a period of time spores are generally produced. These germinate on the leaves, fruit or other parts of the plant under favorable condition, and again produce the disease. On the approach of winter or of seasons inimical to

their growth, many fungi produce special kinds of spores or special parts to tide them over these unfavorable periods. These parts can withstand great extremes of heat, or cold, as the case may be, without injury.

No part of a plant is immune from the attacks of parasitic fungi. The roots, stems, leaves, flowers or fruits may be affected. When roots, or the internal parts of the plant are attacked, control is much more difficult than when the external portions are affected.

Effect of Fungi on the Plant.

Plants attacked by fungi are affected in many ways and malformations very frequently result. Leaves attacked usually become dark brown in spots or over the whole surface. Often they are distorted and wrinkled. As a result they are shortly rendered useless as the food providing organs of the plant. Any interference with the water or food carrying parts of the plant results in wilting. Diseased or dead areas are frequently produced on the trunks or stems of both woody and herbaceous plants. Often on the branches of woody plants large knot-like excrescences are produced. Fruits when attacked usually decay rapidly. Sometimes the pulpy parts dry up and adhere closely to the pit, core or inner parts.

Method of Control.

While spraying is perhaps the most important means of controlling fungous diseases of plants, there are many other methods of greater or less importance to which attention should be given.

1. Dead or diseased plants or parts of plants should be promptly removed and destroyed. Frequently these contain spores, by means of which fungous diseases are spread.

2. All wounds made in pruning trees or shrubs should be painted with white lead paint to prevent fungi from gaining a foothold.

3. Rotation of crops should be practiced. Many diseases are confined to single kinds of plants or to groups closely related. Cabbage, cauliflower, collards and brussels sprouts for instance are closely related. A disease which attacks one is almost certain to attack any other one of the group. So with Irish potatoes, tomatoes and egg plants. Such crops should not follow one another in rotation, neither should any one of them be planted year after year on the same ground. Diseases are certain to accumulate, if this be done. If land becomes infested by disease, it is usually best not to plant crops subject to the disease for three or four years.

4. Conditions and soils particularly favorable to disease should be avoided.

Varieties should be selected which are not subject to disease. Fruit trees which are susceptible to a disease on the roots, may frequently be worked to advantage on disease-resistant stocks.

6. Plants should not be set from disease infested ground into new ground.

Spraying.

General directions for making mixtures: Iron vessels should not be used in preparing the various mixtures. Glass, wood or crockery is best.

Strain all mixtures thoroughly to prevent clogging the pump and nozzles.

Prepare mixtures carefully. Do not do the work in a slipshod manner. Use good materials.

Spraying Mixtures.

30. Bordeaux Mixture.

Copper Sulphate	5 lbs.
Lime (unslacked)	5 lbs.
Water	50 gals.

Dissolve the copper sulphate in two (2) gallons of water, place it in barrel No. 1 and add water to make twenty-five gallons. Slack the lime, reduce it to a very thin paste, place it in barrel No. 2 and add water to make twenty-five gallons. To mix the solutions of lime and copper sulphate, dip a bucketful from both barrels, Nos. 1 and 2, and pour together into the barrel of the spray pump. The two mixtures should flow together as they are poured in. The best arrangement is to have the barrels, Nos. 1 and 2 elevated and use a piece of rubber hose to run the liquids into the pump barrel.

If a large amount of spraying is to be done, a somewhat different policy should be pursued. Too much time would be taken up in preparing the ingredients in small quantities. Instead large amounts of copper sulphate should be dissolved and large quantities of lime slacked beforehand. This may be done as follows:

In a fifty-gallon barrel place about forty gallons of water. Put 100 lbs. of copper sulphate in a sack and suspend it in the water. As soon as dissolved, fill up to the fifty gallon mark. When well stirred, each gallon will contain two pounds of copper sulphate. Each time some of the solution is dipped out, the height of the remaining portion should be marked on the inside of the barrel. Before taking more of the solution out of the barrel any amount of water lost by evaporation should be made good by filling up to the mark last made.

As soon as procured the lime should be slacked, placed in a barrel and kept covered with an inch or two of water. In this way it can be kept indefinitely.

To prepare Bordeaux mixture from these stock solutions, dip out 2 1-2 gallons of the copper sulphate solution, place it in barrel No. 1 and dilute to twenty-five gallons. From the slacked lime take five lbs. or a little more to allow for the water it contains, reduce to a thin paste, place it in barrel No. 2 and add water to make twenty-five gallons. Pour the contents of barrels Nos. 1 and 2 together as already directed.

Tests: If free copper be present, severe injury may be done to the foliage or other tender parts of the plants. Sufficient lime should be added to neutralize it. Dip out a small quantity in a porcelain saucer or shallow bowl and holding it on a level with the mouth blow the breath gently into it. If a thin pellicle forms on the surface more lime must be added. Add and test until it does not form. An excess of lime will not hurt. Another test is to dip the blade of a clean knife into the mixture. If a thin film of copper forms on it after holding it there a minute or so, more lime must be added.

31. Weak Bordeaux Mixture.

Copper sulphate	2 lbs.
Lime	4 lbs.
Water	50 gals.

For peaches and Japanese plums in foliage.

32. Soda Bordeaux.

Copper sulphate	5 lbs.
Washing soda	4 lbs.
Water	50 gals.

Dissolve the copper and washing soda in separate receptacles

and pour them together as in making ordinary Bordeaux mixture. It is said that this mixture has proved considerably more effective than the Bordeaux.

33. Bordeaux Mixture and Paris Green.

Paris green at the rate of four ounces to fifty gallons of Bordeaux mixture may be used for the destruction of biting insects.

34. Copper Sulphate Solution.

Copper sulphate 1 lb.
Water 25 gals.

Sometimes used as a winter spray. It is injurious to foliage and should only be applied before the buds swell.

35. Ammoniacal Copper Carbonate.

Copper Carbonate 5 oz.
Ammonia (26 degrees) 3 pts.
Water 50 gals.

Mix the copper carbonate with a little water so as to form a paste. Add the ammonia and when the copper carbonate is dissolved a deep blue liquid will be formed. Pour this liquid into the fifty gallons of water. If so desired, the copper carbonate dissolved in the ammonia as above, may be kept in a tightly stoppered glass bottle or stone jar and diluted as desired for use. It will keep indefinitely if kept tightly corked.

Ammoniacal copper carbonate is preferable to Bordeaux mixture for use on ripe or ripening fruits, or wherever the stains of Bordeaux mixture would be objectionable.

36. Potassium Sulphide Solution.

Potassium Sulphide 1 oz.
Water 2 gallons.

Dissolve the potassium sulphide in the water and use the solu-

tion immediately or keep in a tightly corked glass bottle for later use.

37. Crude Carbolic Acid and Salt.

(For Foot Rot.)

Crude Carbolic Acid	1 gal.
Water	1 gal.

Cut away the diseased wood and sprinkle the solution over the cut surfaces and the adjoining parts of the roots or trunk.

38. Lime, Crude Carbolic Acid and Salt.

(For Foot Rot.)

Unslacked lime	1 peck.
Crude carbolic acid	4 oza.
Salt	3 lbs.
Water	2 gals.

Slack the lime in the two gallons of water, add the crude carbolic acid and stir in the salt. If too thick, add a little more water. Cut out the diseased parts and paint with the solution.

39. Formalin.

(For Potato Scab and Sterile Fungus.)

Formalin	8 oz.
Water	15 gals.

Soak the tubers in this mixture for two hours.

40. Formalin.

(For Oat Smut.)

Formalin	1 pint.
Water	50 gals.

Soak the grain in this mixture for one hour and a half.

41. Corrosive Sublimate.

(For Potato Scab and Sterile Fungus.)

Corrosive Sublimate 2 oz.
Water 15 gals.

Dissolve the corrosive sublimate in two gallons of hot water, then dilute to 15 gallons. Place the seed potatoes in a sack and allow them to soak in the mixture for one and a half hours. It is best to treat the potatoes two or three weeks before planting them, or they may even be stored for a longer period.

Dust Sprays.

42. Bird Formula.

The following formula for Bordeaux powder is recommended by Prof. R. M. Bird in Bulletin 60 of the Missouri Experiment Station:

Materials required to make seventy pounds of a stock powder:

Four pounds of copper sulphate (blue stone); four pounds of good quick lime; two and a half gallons of water, which is to be added to the quick lime; sixty pounds of air-slaked lime, which has been sifted through the fine sieve mentioned below.

Directions: 1. Break up into small lumps about seventy or eighty pounds of quick-lime and spread it out so that it will become air-slaked. When slaked and perfectly dry sift it through the fine sieve (100 meshes).

2. Completely dissolve four pounds of copper sulphate in two and a half gallons of water. The easiest way is to suspend the sulphate in a coarse bag just below the surface of the water until it is dissolved.

3. Pour gradually two and a half gallons of water over four

pounds of good quick-lime in such a manner as to slake it to the finest powder and give a good milk of lime solution; let it cool

4. Put sixty pounds of the sifted, air-slaked lime into a shallow box—one in which the material can be well worked with a hoe or shovel.

5. Pour the well stirred milk of lime and the copper sulphate solution at the same time into the third vessel containing the lime and stir it until the whole is thoroughly mixed. It will have a deep blue color and be thick. This is so finely divided that it will remain in suspension for hours.

43. Maxwell Formula.

The following combined fungicide and insecticide known as the Maxwell formula is given by Prof. John Craig in Bulletin 216 of the Cornell Experiment Station:

Fresh lime	1 barrel.
Copper sulphate	25 lbs.
Concentrated lye	5 lbs.
Powdered sulphur	25 lbs.
Paris green	6 lbs.

Spread lime in large shallow box, breaking it into as small lumps as possible. Dissolve the copper sulphate in six gallons boiling water; also dissolve the lye in five gallons hot water. Keep separate. Sprinkle copper sulphate solution over the lime; follow with lye solution. If the lime does not all crumble to a dust, use clear water to finish. Screen the lime through a fine sieve, rub the sulphur through the sieve, add the Paris green and thoroughly mix with lime. Lime should crumble to powder, not to granules.

Copper sulphate must be used hot, or the copper will recrystallize. Mixing should be done out of doors or in separate building as lime in slaking becomes very hot.

Explanation of Plates.

Plate III.—Fig. 5, Triplex Power Sprayer, Gould Mfg. Co.; Fig. 6, Niagara Spraying Cart, Field Force Pump Co.

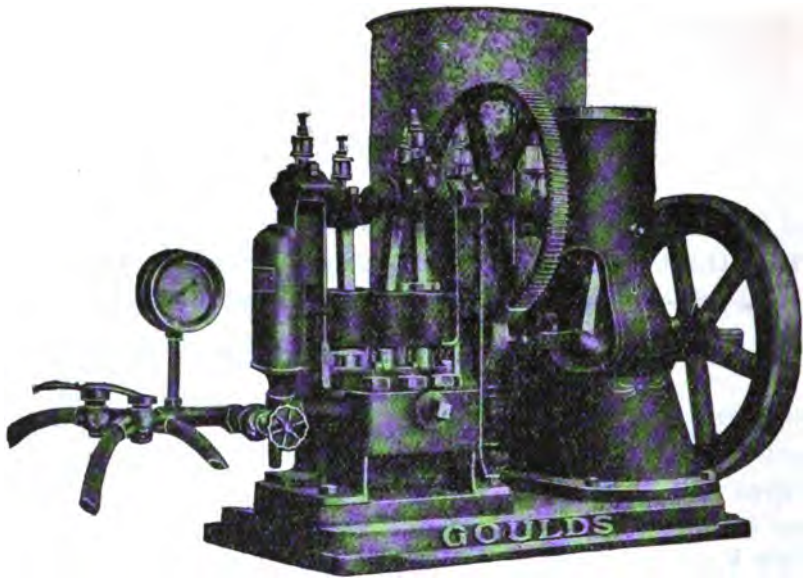
Plate IV.—Fig. 7, Gasoline Engine Spraying Machine, Deming Co. Fig. 8, "Friend" Pump, "Friend" Mfg. Co.; Fig. 9, Lowell Glass Tank Sprayer, Lowell Specialty Co., Lowell, Mich.; Fig. 10, "Monarch" Two-Cylinder Spray Pump, Gould Co.

Plate V.—Fig. 11, Steel Barrel Cart, F. E. Myers & Bro.; Fig. 12, Double Tube Sprayer, F. E. Myers & Bro.; Fig. 13, "Handy" Knapsack Pump, Gould Mfg. Co.; Fig. 14, "Success" Kerosene Sprayer, Deming Co.

Plate VI.—Fig. 15, Lowell Fountain Compressed Air Sprayer, Lowell Specialty Co.; Fig. 16, "Century" Sprayer, Deming Co.; Fig. 17, "Premier" Bucket Pump, Gould Co.; Fig. 18, Double Acting Barrel Pump, F. E. Myers & Bro.; Fig. 19, Good News Compressed Air Sprayer, Field Force Pump Co.

Plate VII.—Fig. 20, Jumbo Dust Sprayer, Leggett & Bro.; Fig. 21, Bamboo Extension Rod, Gould Co.; Fig. 22, Double Vermorel Nozzle, Field Force Pump Co.; Fig. 23, "Mistry" Nozzles, adjustable at any angle, Gould Mfg. Co.

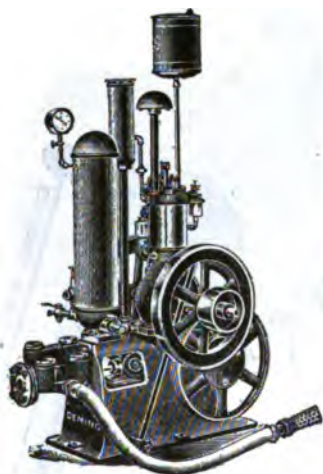
Plate VIII.—Fig. 24, Single Vermorel Nozzle, Deming Co.; Fig. 25, Bordeaux Nozzle, Deming Co.; Fig. 26, Hop Nozzle, F. E. Myers & Bro.; Fig. 27, Vermorel Nozzle, F. E. Myers & Bro.; Fig. 28, Double Vermorel Nozzle, Gould Co.



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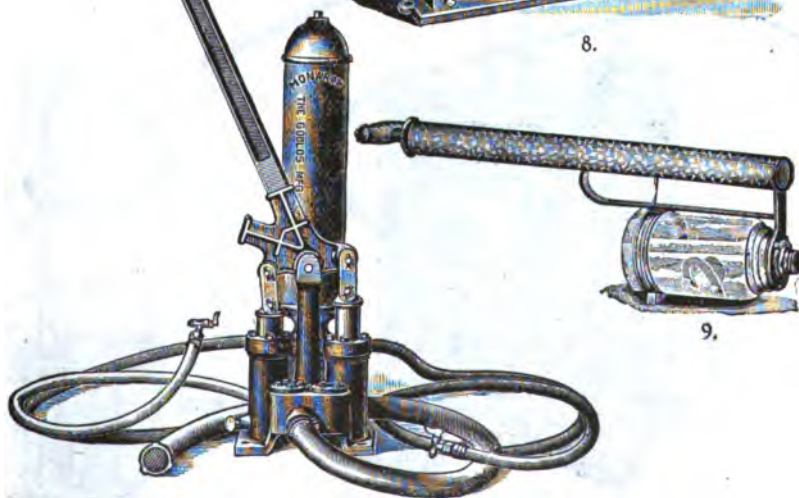
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PLATE III.



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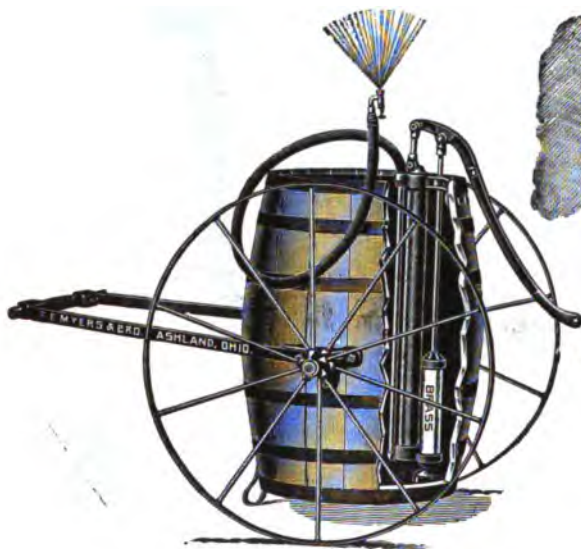


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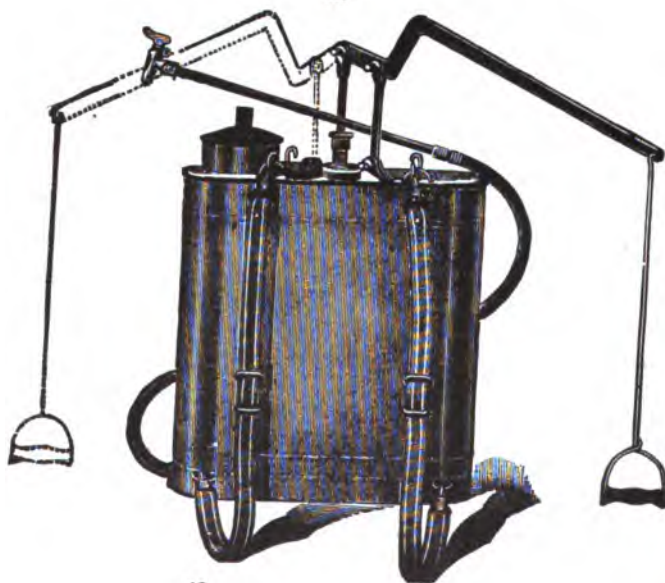
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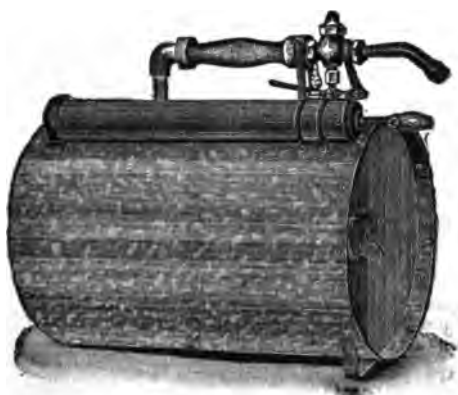


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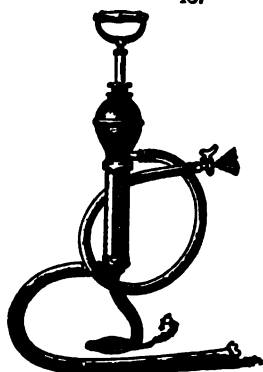
PLATE V.



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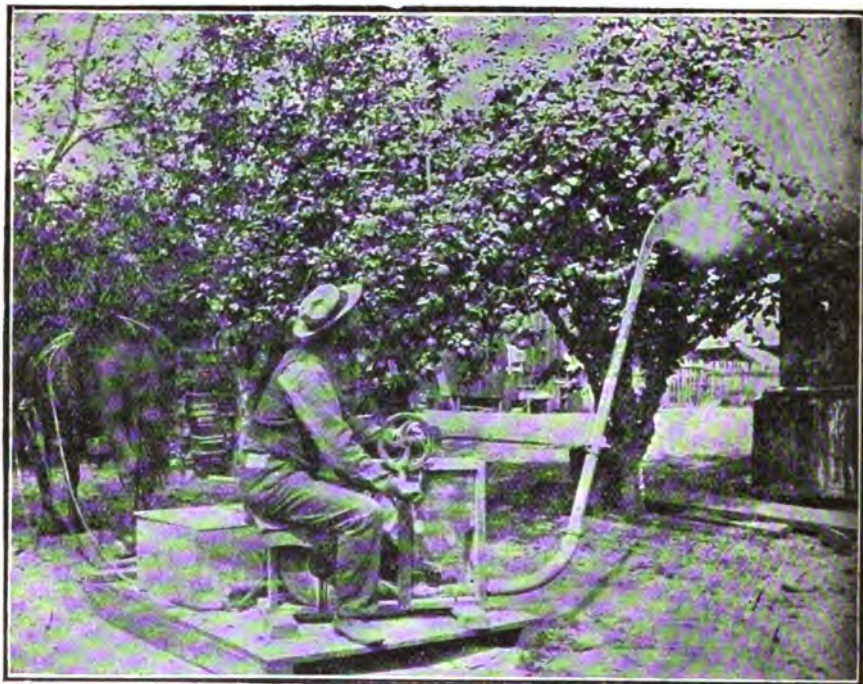


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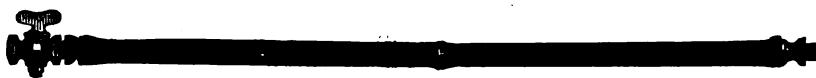


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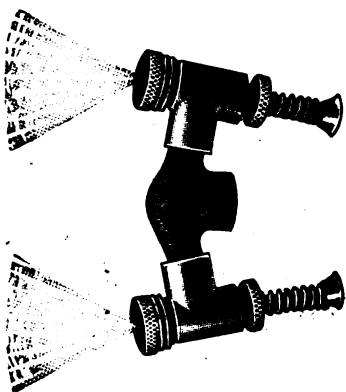
PLATE VI



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PLATE VII.



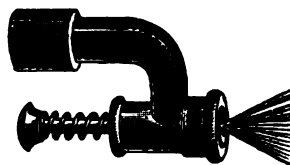
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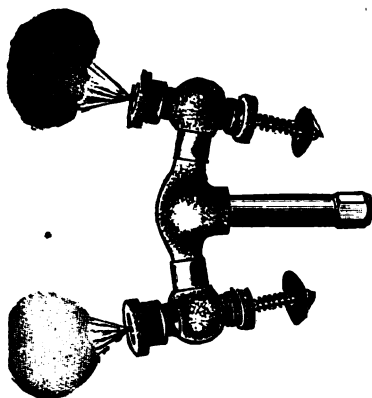
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PLATE VIII.

The following publications of the Florida Experiment Station are available for free distribution, and may be secured by addressing the director of the Experiment Station, University of Florida, Lake City, Fla.:

23 Fertilizers.....	pp. 48	54 Pecan Culture.....	pp. 31
24 Annual Report.....	" 32	55 Feeding With Florida Feed Stuffs.....	" 96
25 Leeches and Leeching.....	" 17	56 The Cottony Cushion Scale.....	" 48
26 Big Head.....	" 19	57 Top-working of Pecans.....	" 124
27 Pineapple.....	" 14	58 Pomeelos.....	" 43
28 Liver Fluke — Southern Cattle Fever.....	" 15	59 Canillflower.....	" 20
29 The San Jose Scale.....	" 23	60 Velvet Beans.....	" 24
30 The Culture of Tobacco.....	" 23	61 Two Peach Scales.....	" 32
32 Cotton and Its Cultivation.....	" 4	62 Peen-to Peach Group.....	" 22
33 Orange Groves.....	" 33	63 Packing Citrus Fruits.....	Folio
34 Insect Enemies.....	" 96	64 Texas Fever and Salt Sickness.....	pp. 31
36 Insects Injurious to Grain.....	" 31	65 The Kumquats.....	" 14
37 Pineapple.....	" 15	66 The Mandarin Orange Group.....	" 32
38 Tobacco in Florida.....	" 63	67 The White Fly.....	" 94
39 Strawberries.....	" 48	68 Pineapple Culture. I. Soils.....	" 35
40 The Fall Army Worm.....	" 8	69 Cultivation of Citrus Groves.....	" 30
41 The San Jose Scale.....	" 30	70 Pineapple Culture. II. Varieties.....	" 32
42 Some Strawberry Insects.....	" 55	71 Japanese Persimmons.....	" 48
43 A Chemical Study of Some Typi- cal Florida Soils.....	" 123	72 Feeding Horses and Mules on Home-Grown Feed-Staffs.....	" 16
51 Some Common Florida Scales.....	" 24	73 The Honey Peach Group.....	" 20
53 Baking Powders.....	" 15	74 Anthracnose of the Pomeelo.....	" 20
53 Some Citrus Troubles.....	" 35	75 Potato Diseases.....	" 16

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3 Seed Testing.....	28 Moon Blindness.....
4 The White Fly.....	29 Food Adulteration.....
5 Basic Slag.....	30 Dehorning Cattle.....
6 Nursery Inspection (part 1).....	31 Coffee.....
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21 Parturient Paralysis.....	46 Selecting Seed Corn.....
22 Nitrogen as a Fertilizer.....	47 The Rabid Dog.....
23 Protection Against Drought.....	48 Adulterated Drugs and Chemicals.....
24 Orange Mites.....	49 Saw Palmetto Ashes.....
25 Roup.....	50 Insect Pests to Live Stock.....

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BULLETIN No. 77.

FEBRUARY, 1905

• FLORIDA •
AGRICULTURAL EXPERIMENT STATION.
DEPARTMENT OF VETERINARY SCIENCE.

Equine Glanders and Its Eradication.



A Victim of Glanders and Farcy.

By C. F. DAWSON, Station Veterinarian.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

St. Augustine, Fla.:
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1905.

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EXPLANATION OF PLATES.

PLATE No. I, *Fig. No. 1*—Note the discharge from the left nostril; the farcy buds on the outside of the left front limb, on the neck and along the left side of the chest and abdomen. The white streak across the root of the neck is a collar mark.

Fig. No. 2—Same case showing farcy buds on outside of left hind limb and on inside of right hind limb.

PLATE No. II—Map of Florida, showing locations of outbreaks of glanders described in this bulletin. Note the proximity of Orlando, in Orange county, to the points where glandered animals were found. Orlando is the horse-market for this region, and, with the exception of the Monticello and Tampa cases, was probably the original source of infection. There were nine cases at Zolfo, three at Tampa, five at Lady Lake and Conant, seven at Leesburg, one at Sanford, one at Monticello, five at Winter Park, and ten at Narcoossee, Peghorn and Gentry; forty-one in all, the money-loss aggregating probably six thousand dollars.

GLANDERS.

History.—Glanders, or farcy, is one of the oldest and most dangerous diseases of the horse. The disease was known to such early medical writers as Aristotle and Hippocrates. Also the Roman authors, Apsyrtus and Vegetius described the disease, the latter recognizing the nasal and skin forms as being identical. It is an infectious disease, and was so recognized in the seventeenth century. In the Middle Ages the German law considered it constituted an unsoundness, and a sale of a glandered animal thus became null and void. Toward the end of the eighteenth century, two Danish scientists, Abildgaard and Viborg, proved by experiment that glanders could be transmitted from an affected animal to a healthy one; that the cause of the disease is a fised virus, which leaves the body in the secretions or pus from the ulcerated surfaces; that the blood of the infected animal is far less potent to infect than are the discharges from the nose and ulcerated skin. Experiments made about the same period in England confirmed those made in Denmark, it being, at the same time, recognized that the nasal discharge is the principal carrier of the virus.

Notwithstanding these conclusive experiments in Denmark and England, the theory of the contagiousness of glanders was doubted, at the beginning of the nineteenth century even, by such eminent veterinarians as the professors in the famous Alfort Veterinary College, in France. They held that glanders arose from a previous attack of strangles, or distemper. The French government, accepting the Alfort doctrine, removed its restrictions against the disease, and glanders spread to an alarming extent in France. When, in 1837, Rayer proved the transmissibility of glanders to man, and when Chauveau, in 1868, demonstrated that the infecting principle was contained in the diseased tissues, it was again generally accepted that glanders is a transmissible disease. Scientists now made use of the new science of bacteriology to discover the microbe which everyone believed causes the disease. In 1868 a fungus was named as the cause, by Zuern and Hallier. Other workers attributed the disease to new microbes which they encountered in their search; but it was not

until the advent of new and improved methods of isolating microbes from infected matter were invented, that progress was made in the right direction. In 1882 two German bacteriologists, Loeffler and Schuetz discovered a microbe which all now recognize as the cause of glanders.

The Microbe.—The cause of the disease is a rod-shaped bacterium from one to three micromillimeters long ($\frac{1}{25000}$ to $\frac{3}{1000}$ inch) and about one-fifth of these measurements in thickness. The rods are straight with rounded ends, or they may be slightly curved, and are frequently found lying in couples, side by side. They easily stain in the dyes, especially in methylene blue, fuch-sine, or gentian-violet. New growths of the organism on gelatin nutrient medium at first appear as yellowish, translucent drops, which later assume a milky-white color. On the media generally there is nothing in the appearance of the growths which is remarkable. On potato, however, we find a growth which may be said to be typical of the glanders microbe. The growth, at first amber-colored, changes, in a week, to a copper color, and the neighboring parts of the potato take on a greenish hue. The microbe grows luxuriantly on all the ordinary media, but best on blood serum of horses and sheep; on beef-broth, and on sliced potato. While it can vegetate at the ordinary room temperature, its development is favored by the body temperature. It does not multiply in the filth of stables. It is killed in a week by drying, and experiment has shown that the microbe will remain active in the filth of stables for about three or four months. It will live in putrefying material for from two to three weeks, and retains its virulence in water for fifteen to twenty days. Some authors claim the microbe forms spores, others deny this property. The rods frequently show light spaces when subjected to stains, and it may have been these vacuoles which were mistaken for spores. The writer has never observed any spores. This microbe is fairly resistant to germicides, but its resistance would be many times increased if it possessed the spore-formation property. It is killed by a 5-minute exposure to a 3 per-cent. solution of carbolic acid, or a 1-1000 solution of corrosive sublimate. For all practical purposes, a 5 per-cent. solution of creolin, or carbolic acid, or a 1-1000 solution of corrosive sublimate, is sufficient for its destruction.

Its Occurrence and Statistics.—Glanders is an infectious disease of horses, mules, jennets, field-mice, guinea-pigs, cats, lions,

tigers, dogs, goats, rabbits and sheep, the comparative susceptibility being in the order named. Cattle, pigs, house-mice, white rats, pigeons and chickens are immune. Horses vary greatly in their individual susceptibility to the disease. Some take it readily, while others kept in the same stable with a glandered horse fail, for some reason, to take it. This is, of course, true of most diseases. If it were not, it is obvious there would be very few animals. There are, however, certain conditions to which an animal may be exposed, which predispose to its development, the chief of these being: Over-work, underfeeding, cold, damp, draughty stables, poor ventilation, chill and debilitating diseases. The disease spreads fastest in times of war. It occurs in all countries, regardless of climate. It is said, that owing to the strict sanitary regulations in Australia the disease has not gained a foothold there. Although glanders is by no means as common as formerly, it is still considered the most dangerous horse disease. Man sometimes takes the disease, and it is regarded as a uniformly fatal malady. In one outbreak on the Polish-Russian frontier, twenty cases in man were reported. Equine glanders is, naturally, most prevalent in those countries having the densest horse population. In Austria during the years 1877-87, there were 3,317 cases reported. In Hungary in the years 1891-2, 1,600 horses were glandered. France and Germany each had reported 5,623 cases in four years. Great Britain had 8,000 cases in the same period. London, alone, had nearly 800 cases in 1890. As there is no Federal law in the United States requiring a report of cases, no exact statement can be made as to the number which occur. Glanders was very common here just after the Civil War; but owing to the great increase in the number of professional veterinarians, and the adoption of veterinary sanitary laws by various states, there can be little doubt the disease is on the decrease.

Its Transmission.—Glanders may be transmitted directly from an infected animal, or it may be transmitted indirectly by infected food, feeding and drinking-troughs, harness, clothing, stable utensils, bedding and attendants, when any of these become contaminated with the discharges from the ulcers on the skin or in the nostrils. The vast majority of horses become infected by the microbes entering the respiratory tract. The microbe or virus of glanders will remain alive under natural conditions of the stables for four months; hence a stable in which

a glandered animal has discharged virus will retain its infectiousness for four months after the glandered animal has been removed, provided it has not been disinfected. While the discharges from the nose and skin ulcers contain the virus in the most infectious form, it has been shown that the microbes may occur in any of the organs. When the disease becomes generalized the bacilli may be demonstrated in the blood by inoculating susceptible animals. Glanders cannot be said to be a disease which moves from place to place very rapidly. It will not jump from one stable to another of itself. It must be carried by an infected animal or by some of the means enumerated above. There are numerous instances where its spread through a stable was by slow degrees; spreading from a stall to adjacent ones. Naturally, in stables where horses do not have their regular stalls, or where they feed from a common trough, the disease may be expected to spread with great rapidity. In one outbreak in the experience of the writer, there was an unusually high percentage of cases co-existing by reason of the fact that the owner allowed the first case to wander into the other stalls. The result was that five of his six healthy horses all contracted the disease at about the same time. While, as a rule, there are many animals which escape the contagium, it is doubtful if any horse or mule is naturally immune from the disease. Those which fail to contract the disease, escape by virtue of conditions probably unknown to us at present. When this can be explained for glanders, we shall also have an explanation why people escape certain diseases. Natural immunity, no doubt, is the chief protector; or it may be that there are very mild attacks of this, as well as of other diseases in both animals and people which are clinically unnoticeable, but which confer sufficient immunity to repel mild infections which happen along during conditions of the economy when every organ is performing its functions in a normal manner. There may be no such condition as that which we understand by the term *natural immunity*. It may be that immunities against all diseases must be acquired. When one deals with such infinitesimally-small objects as the pathogenic bacteria, and realizes the inconceivable number of ways in which they may be transported, it is difficult to get a clear understanding of what they may or may not do, and of how many ways they may perform their work. The science of modern bacteriology is only about forty years old, and the age of the improved mod-

ern bacteriological methods of research is a little over twenty years. Who would say that so intricate a science could be fully developed in so short a time? Even at this stage of the subject, we are studying diseases which we have every reason to believe are caused by bacteria or protozoa that are too small to be seen by the best microscopes at our command to-day. Radical changes in the ordinary methods of nutrition and incubation have been made for investigating these new forms of disease-producers, and, no doubt, we are just on the threshold of our most important discoveries, and that all the discoveries of the last forty years will pale into comparative insignificance, in the future.

Pathogenesis.—In 90 per cent. of cases the point of entrance of the virus of the disease is the respiratory tract. The microbes probably gain entrance into the nasal chambers and finally the lungs by being inhaled with the dust which arises from infected feeding troughs, or by the animal's smelling at the nose of its infected neighbor. Experiment shows that the more probable vehicle of infection is the virus-laden dust; because it has been found impossible to infect animals by having a susceptible horse breathe the expired air from a glandered one. It is supposed by some that a diseased or catarrhal condition of the lining of the nasal chambers or bronchi predisposes to, or aids in the production of the disease in exposed animals. Others allow the claim, but hold also that the bacilli of glanders may, like those of tuberculosis, actually penetrate the mucous membrane of the respiratory tract and start up the disease process. The disease may have its origin either in the nasal chambers, or in the lungs; but actual observations prove that in many cases, even where both lungs and nasal chambers were found affected, that the lesions in the lungs were the older. In some cases, the bacilli are discharged from the lungs into the nasal cavities, and these parts became diseased. In other cases, the lungs only may be affected, and hence the appearance of the characteristic nasal ulcers are not present to aid in the diagnosis.

The skin is a second organ through which the microbes may enter. When the skin is affected the ulcers formed are known as farcy buds or the name farcy is applied. This form was formerly not recognized as glanders, and even to-day many horsemen deny their identity. As the microbe can only gain entrance into the skin through abrasions, it is not a common thing to see glanders start primarily in the skin. The skin is generally secondarily

affected, when the disease is generalized, or when the bacilli are absorbed into the circulating blood from a lesion in the lungs or elsewhere. They are then arrested at various points, some of which may be in the extremities or ventral aspect of the body, and here we find the formation of the characteristic farcy buds, or ulcers. Experiment has shown that it is impossible to cause the bacilli to enter the unbroken skin by friction. In some cases where it was possible to thus inoculate the disease, it is to be assumed that the skin was abraded.

That infection takes place rarely through the digestive canal, in the horse, has been proven by feeding them with glanderous matter. While a few cases became infected by this channel, the majority escaped. It is possible that those which became infected had abrasions of the lining of the mouth or other parts of the digestive canal. Man also is immune from infection through the alimentary canal, as has been demonstrated in besieged cities, notably during the siege of Paris. On the other hand, the carnivora, dogs, cats, lions, tigers, panthers and bears are frequently infected by feeding on the carcasses of glandered animals. It is also known that a glandered stallion may infect a mare during coition, and that a glandered mare may give birth to a glandered colt, in which case, the microbes of the disease infect by passing from the mother to the foetus *in utero*.

Glanders as a rule first invades the lungs. Here the disease spreads, finally invading the bronchial tubes. From these the virus is discharged into the trachea and thence into the larynx, pharynx and nasal chambers, where a secondary infection is set up. From these foci the bacilli may be rapidly absorbed into the blood stream and the disease become general and acute. In a large proportion of cases in the horse, the disease begins in a chronic form and becomes acute in the manner described. In the majority of cases in mules, the disease is acute from the onset. The same is true of infections in man.

Varieties of Glanders.—We distinguish glanders of the nostrils, glanders of the lungs and glanders of the skin according to the location of the disease in nostrils, lungs or skin. Formerly true glanders was admitted as existing when the lungs and nostrils, or either of these organs was affected. When the skin alone was affected, it was called farcy, and when nostrils, lungs and skin

were simultaneously affected, the disease was known by the name *glanders* and *farcy*.

There are two forms of glanders, one the chronic and the other the acute form. These names are applied according to its progress. Chronic glanders is more common and affects horses mostly. Acute glanders occurs in about 10 per cent. of the cases in horses, and is the most common form in the mule. Acute glanders is rapidly fatal and never becomes chronic; but chronic glanders becomes acute and kills by doing so. The chronic form becomes acute when the circulating blood absorbs the bacilli from pre-existing disease centers, and deposits them throughout the body.

Pathological Anatomy in the Chronic Form.—The anatomical changes which occur in this form are essentially specific inflammatory processes which cause suppuration, ulceration, granulation and scarring. These occur in the nostrils, pharynx, larynx, trachea, bronchi, lungs, lymphatic glands, and the skin; sometimes other organs are diseased also.

The nostrils is the usual seat of the disease. It exists here either as discrete nodules, forming ulcers and scars; or as diffused patches of ulcerations; the former form being that ordinarily seen. The nodules are found situated on the lining membrane of the nasal chambers chiefly in the upper portion of the cavity on the nasal septum and on the surfaces of the scroll-like or turbinated bones. The nodules first appear and vary in size from a grain of sand to a millet seed, and are glassy, translucent, round or oval in shape and of a dirty-grey or greyish-red color. They project above the surface and never get larger than a pea. They may appear singly or in groups. They are composed of lymphoid cells which later disintegrate into purulent matter at their summits, and the nodule becomes yellowish in color. The nodules thus become hollowed leaving a hard, prominent ridge, and resemble a crater. These ulcers sometimes run together or become confluent and surrounded by a hard, prominent ridge or wall and have a yellowish or whitish base. Sometimes they are covered by a brownish crust, which when removed show the above-described characters. These ulcers may increase in breadth and depth, and may finally entirely perforate the bones on which they lie; or they may cause an enlargement of the maxillary bones and cause the face to appear swollen. The shallow ulcers heal without leaving

PLATE NO. I.



Fig. No. 1.



Fig. No. 2.

any trace of their former existence, but the deeper ones heal by a scarring which is characteristic of the disease. These scars are star-shaped, smooth or horny, and may be of an irregular, oblong form. They are most easily seen on the nasal septum, or on the inside surface of the wings of the nostrils. These ulcers may be too high up to be seen and still, at the same time, they may be found, on post-mortem, existing in the posterior nares, the frontal and maxillary sinuses, the pharynx, the larynx and trachea, where they cause thickening of the parts and the discharge of the glanderous virus from the catarrh which accompanies them.

When the disease in the nasal cavities takes the form of diffuse patches, there is a catarrhal thickening of the mucous membrane, and hardening of the structures underneath it. The veins of the parts become plugged and the parts heal with the formation of peculiar radiating scars.

The disease in the lungs takes on both the nodular and diffuse forms. The nodules here have about the same characters as in nasal chambers. In some cases the suppurating nodules become enveloped in a capsule and in others they burst and form cavities. Accompanying these nodular formations, which give the impression that they are embedded shot when the hand is passed over the lungs, are chronic bronchitis, collapse of part of the lungs, and in some cases, pleuritis.

In the diffuse form of the lungs, tumors varying in size from a walnut to a child's head, occur. These tumors are formed by the filling up of the expanded endings of the bronchi with glanderous matter. They are of a dirty-white color, gelatinous in consistence and of irregular shape. They may either become hardened or gangrenous. In both the nodular and diffuse lung forms, the lymphatic glands at the root of the trachea become hardened and enlarged from the disease.

In skin glanders or farcy the nodules are found in the superficial layers of the true skin, in the tissue beneath the skin and in the inter-muscular tissues. These nodules in the skin, which vary in size from a small seed to that of a pea, soon suppurate and form small ulcers. Those which form under the skin are larger, sometimes reaching the size of a hen's egg. They form large abscesses, and open outwards. We then find long, sinuous ulcers from which escapes a yellowish, sticky discharge. Radiating from these ulcers we find the lymphatics which are swollen and knotted

into cords, the popular name for them. Along these cords ulcers often develop. At first these lymphatic glands are soft, swollen and painful; but later they become hard and painless. In some rare cases the secondary farcy may take on the condition of general thickening of the skin of the limbs and head.

Of the other organs, the spleen suffers oftenest. The nodules vary in size and generally become calcareous; or they may suppurate. Of other organs affected we may find the liver, kidneys, testicles, brain, muscles, heart and bones. It rarely affects the eyes and stomach. The bacilli also enter the circulating blood, and when this occurs, we have an acute general infection.

Pathological Anatomy of the Acute Forms.—The pathology of acute glanders is found chiefly in the mucous membrane of the respiratory tract; in dropsical swellings in skin; and in suppuration of the lymphatic vessels and glands of the skin and lungs. The membranes in the nose are studded with rapidly-spreading ulcers and the tissues beneath the membrane are much thickened. The larynx and pharynx are similarly affected. The lungs are studded with abscesses and fresh nodules. The skin is swollen and corded.

The following statistics show the relative distribution of the disease process in the various organs, as given by one author: In 3,317 glandered horses, 1,529 had the disease in the nostrils only; 294 only in the lungs; and 218 only in the skin. In 846 cases, both nostrils and lungs were affected; in 217 cases, nostrils, lungs and skin; in 164, nostrils and skin; and in 49, lungs and skin. In 216 *post mortem* examinations, the lungs were found to be free from the changes of glanders only in 10 cases; and in 173 other autopsies, only in 28 instances. It thus appears that the lungs are affected in the large majority of cases, in this disease.

Symptoms of Chronic Glanders.—Most cases are said to start in the chronic form because the early stages escape notice. These early stages may cover a period of several months or as many years. Although it would thus seem that the stage of incubation is a long one in most cases, experiment has shown that it is really only from three to five days.

The first noticeable symptom is a nasal discharge from one nostril of a dirty white mucus. Sometimes the discharge is from both nostrils. Later on the discharge becomes grey or greenish-yellow, sometimes streaked with blood, and is sticky. The amount

of blood depends entirely upon the size of the blood-vessels which have been eaten through by the ulcerative process. Sometimes the bleeding is profuse, and the animal may bleed to death.

Nodules and ulcers may be found on the nasal septum, near the nostrils, or they may be situated too high up to be discovered by an ordinary examination; or they may not appear till late in the disease. The ulcers have hard, elevated, precipitous borders, and the base is yellowish white in color. When they heal, a characteristic, long scarring is seen.

With these symptoms is associated swellings of the submaxillary lymphatic glands. The swelling is at first doughy and painful. Later on the glands become nodular, hard, painless, and adherent to the jaw bone as well as the skin; so that it is not easy to move them. These glands rarely suppurate. In cases where the membranes of the nose are not infected, and sometimes early in the disease, the glands of the jaw are not affected. They will, however, always be found enlarged where a glanderous ulceration of the nostrils has existed for some time.

The condition of the animal is an important symptom. The animal loses "condition"; is quickly fatigued; the coat is dry and harsh; there is cough and labored breathing as in "broken wind." There may be fever and slight or severe bleeding at the nose, when the animal is at work. Late in the disease there are swellings of the limbs, belly, chest and joints.

In the chronic form of the disease, the skin is not so often affected, as in the acute form. Its favorite location is on the limbs, shoulders, breast and belly. The nodules or boils vary in size from a pea to a walnut. They frequently heal, leaving evidence of their former presence. They almost always ulcerate, however, forming sinuous ulcers which discharge a sticky, discolored liquid. The lymphatic ducts leading from these ulcers are swollen and corded, and these often ulcerate. The animal frequently shows a periodical lameness in the affected limb.

The progress of the chronic form is extremely slow. Several weeks or months must elapse before the first visible symptoms present themselves. The time required for a chronic case to show depends largely upon conditions. In animals that are overworked and underfed, or those that suffer from any devitalizing influence or disease, the disease would manifest its presence much sooner. Well pronounced cases often apparently heal up under good care

and absolute rest. These are the cases which persons who are ignorant of the disease claim get well. By the use of the diagnostic agent mallein it has been shown that a large percentage of cases show no external evidence of the existence of the disease.

Symptoms of Acute Glanders.—Acute glanders may be said to be rare in the horse, inasmuch as only about 10 per cent. take this form. In the ass and the mule, the acute form is the rule. It may begin as acute glanders, or a chronic case may become acute. When inoculated into the skin either by accident or design it starts in as the acute form. This form is very rapid in its progress, the process being septic and accompanied with gangrene of the mucous membrane of the respiratory tract, and by spreading to the skin and lungs by metastasis.

The first symptom is a chill followed by a fever which may rise to 104 or 5° F., and the commencement of a thick nasal discharge which soon becomes thick and reddish from the admixture of blood and serum. Owing to the throat being affected the food is sometimes seen mixed with the nasal discharge. The course of the disease is so rapid that gangrene of the parts affected may take place in two or three days. The breathing is difficult and noisy. There is snorting, rattling, groaning, and when the larynx is invaded, there is roaring.

The following symptoms also appear in the skin: dropsical swellings; the formation of nodules and ulcers; the development of a cord-like condition of the lymph channels, and the swelling and suppuration of the lymphatic glands, particularly those in between the bones of the lower jaw. There is loss of appetite, difficult swallowing, diarrhoea and rapid loss of flesh. In acute glanders death occurs in from three to fourteen days.

The Diagnosis of Glanders.—The early diagnosis of glanders is, perhaps, more important and, withal, more difficult and uncertain than any other disease of the horse.

In a well-developed case, no mistake would be likely to be made by any one who had had a previous experience with the disease. In a well-marked case, the chief clinical symptoms are as follows: a purulent, tenacious and rather clear nasal discharge from one nostril; nodules and ulcers in the nostrils with a dirty-yellow base, and raised, thickened edges; hard, uneven swelling of the glands between the jaws which are firmly adherent to the skin and bone; farcy buds and boils on the skin, with ulcers and

a corded, knotted condition of the lymphatic glands; doughy swellings of the skin of a leg, on the belly and under-surface of the chest; rough coat; loss of condition; fever; short wind; cough; bleeding from the nose; dejection. These symptoms are not always present in their entirety. Sometimes only one or two of them may be present, and then a diagnosis is difficult, or impossible. Although a discharge from one nostril is always to be regarded as suspicious, it is by no means proof of the existence of glanders. There is frequently a discharge from both nostrils. When the disease strangles becomes chronic we find hard, enlarged, painless swelling of the glands lying near the wind-pipe and, in this, simulating the same condition found in glanders. Again, the swollen glands between the jaws in glanders rarely if ever suppurate. While this symptom was, at one time, regarded as one of great value, in doubtful cases, we have other diseases in which this may occur. The one exact symptom of the disease may be said to be the appearance of the characteristic ulcers in the nostrils, with their eroded, raised edges and peculiar base. These ulcers may be present independent of a nasal discharge, so it is of great importance to make a thorough inspection, paying particular attention to the under side of the wings of the nose.

Special Methods of Diagnosis.—In addition to the ordinary methods of diagnosis there are special methods which may be employed in cases where the ordinary symptoms are not developed. These cases are called *occult* glanders. It is well known that devitalizing conditions may stimulate the disease to renewed activity by removing the natural resistance of the animal. One of these conditions is fever. Fever may be artificially produced by hard work and underfeeding in such cases. The injection of the oil of turpentine under the skin has also been used to make manifest the symptoms, by changing a chronic, occult case into an acute case in which one or more of the well-known symptoms will appear.

Another method, consisting of the inoculation of other susceptible animals with the discharge from a suspected case. This is really the most valuable and reliable of all the methods. The animals to be chosen are asses, horses, mules and guinea-pigs. The expense, under ordinary conditions, places the method beyond the ordinary practitioner; hence it largely remains for those institutions supporting pathological laboratories to utilize this

method. In laboratories the guinea-pig is the animal used. Several male guinea-pigs are inoculated intra-abdominally with varying quantities, each small in amount, say from one-tenth to five-tenths of a cubic centimeter of diluted nasal discharge. In case there be no nasal discharge, which often happens, a cotton swab is passed into the nostrils through their whole length, and is washed out in a test-tube containing sterile water or bouillon. Varying quantities of this suspension are injected intra-abdominally as stated above. If the material injected contain glanders bacilli, the guinea-pig will show, in from 24 to 48 hours, a violent inflammation of the scrotum. If the experiment be prolonged, other symptoms of glanders will appear, viz.: ulceration of the testicles, of the nasal septum, of the lips and toes, and the invasion of the internal organs. It sometimes happens that a guinea-pig receiving a large dose of the virus will die in a day or two. The death will not be due to glanders, but to presence of septic germs in the injected material. For this reason, it is best to inoculate, as stated, with varying amounts of the virus. The microbe of the disease can be demonstrated by means of the microscope and the employment of stains, in the affected tissues of such guinea-pigs.

Diagnosis by Mallein.—Mallein is an extract of old glycerine-bouillon cultures of the glanders microbe. The material is made by first sterilizing the cultures by heat. The dead microbes are then filtered out by means of clay filters, and the liquid filtrate is then evaporated down to one-tenth of its original volume. These procedures produce a syrupy, dark-brown liquid, concentrated mallein, which is practically a solution or suspension of the glanders toxin in glycerine. As such, it will not decompose. When the mallein is to be used, it is brought up to its original volume by the addition of 0.5 per cent carbolic acid solution.

Although the utility of mallein as a diagnostic agent has been questioned by some authors, it is being used by the various governments, including National, State and municipal.

In carrying out the mallein test, the following method should be employed: The temperatures for the preceding day taken every two hours should, if possible, be at hand for reference. If this is impracticable, begin taking the temperature at six o'clock in the morning and repeat at eight, and ten o'clock. At eleven o'clock inject the dose of mallein under the skin of the lower third of the

right side of the neck. The large extent of flat surface existing in this location renders it more easy to judge the effects of the injection. Horses with fever from any cause are unsuitable for this test. About six hours after the injection of the mallein, take the temperature, and repeat taking it every two hours up to the twenty-first hour. If the animal has glanders three well-marked deviations from the normal condition will be noted and maintained for at least 24 hours after the injection, as follows:

1. A hot, painful tumor which may attain a size of nine inches in diameter, at the point of injection, and radiating from it swollen lymphatic ducts and glands similar to the cords in like situations in well-marked cases of the disease.
2. A well-marked rise of the temperature of two degrees or more, which is maintained for at least 24 hours.
3. A well-marked constitutional disturbance, manifested by depression, debility, loss of appetite, stiffness of the muscles of the fore-legs and embarrassed respiration.

While some regard a rise of temperature of $1\frac{1}{2}$ degrees and tumor-formation as indicating latent glanders, my experience has been, that we should not condemn unless the fever remains up, over 24 hours, and the tumor attains a size of at least five or six inches and remains hot and painful. When these two signs prevail, the third, that of dejection, will always be present. My practice has been to release all animals that do not present these symptoms, and my experience, so far, proves that the practice is safe.

In a case of well-marked, acute glanders, I injected with mallein for the sake of experiment. The result was that, instead of a rise in the temperature, as in latent cases, there was an actual fall in the temperature of two degrees, and there was little or no reaction at the point of inoculation. This argues a toleration for slight increase of the toxin in animals where the system is already saturated with the poison.

Differential Diagnosis.—Glanders may be mistaken for a number of affections, of which the following are the most important:

1. *Chronic nasal catarrh* most, of all, closely resembles glanders. In this disease we find the nasal discharge, swollen intermaxillary glands and sometimes skin ulcerations. As points against a mistake, we find no scarring of the nasal chambers. The

disease is easily checked by local applications to the nasal mucous membranes and the internal administration of a tonic. The disease does not spread to other animals, and inoculations of guinea-pigs would not cause glanders in them. There would not be that loss of condition which we find in a case of glanders which had progress so far as to attract attention by the appearance of a nasal discharge, etc.

2. In *strangles or distemper* we observe inflamed lymphatic glands with ulcerations about the head and throat. The rapid healing of these, and recovery of the animal make the diagnosis certain. Even in cases of strangles where the disease spreads to other parts of the body by metastasis, there can be little cause for mistakes. In strangles there is a decided tendency to abscess-formation, while in glanders we find ulceration. Strangles is usually found in young stock, especially after shipment, while glanders attacks horses of all ages. Strangles is more rapid in its development and course, and the nasal discharge is bilateral, and whitish in color.

3. *Parasites* in the nasal chambers sometimes cause a discharge resembling that in glanders.

4. *Lymphangitis* may be mistaken for glanders of the skin or farcy. This is usually a local affection, *i.e.*, it is confined to a limited area, such as a single limb. It progresses rapidly and there is a tendency to abscess-formations, while farcy progresses slowly and without, generally, abscess-formation. The abscess and resulting ulcer of lymphangitis has smooth edges and heals rapidly by granulation, while the ulcers of farcy heal slowly, have thickened, raised borders, and heal leaving scars. In farcy the lymphatic channels are thickened forming cords, while in lymphangitis the adjacent tissues are also swollen.

5. In *petechial fever* or *purpura haemorrhagica*, there is not as much fever present as in glanders, and the swellings in the former disease are much more extensive and never nodular. This disease is, moreover, the sequel of a pre-existing debilitating affection.

Treatment.—That an occasional spontaneous recovery from glanders may take place, is accepted. No medicinal measures yet known to the profession can be wholly accepted as curative. While it is true that some reliable practitioners claim that repeated injections of mallein will cure the disease permanently, it is not yet satisfactorily settled. Enough is promised, however, in this

line, to warrant those in a position to do such work, to give the method an extensive trial. Such an experiment would have to be extended over a long series of years to test its efficacy.

At present the only safe method of dealing with glanders, is to apply the strictest sanitary measures. This consists in the immediate destruction and deep burial, in lime, of all visibly-affected animals; the testing with mallein of all animals that have come in contact with those sick, and the destruction of those that react to the test; the thorough cleaning and disinfection of all harness, stable utensils, wagon poles and shafts with a bi-chloride of mercury solution; the removal and burning of feed and drinking troughs, stall partitions, brushes and pads, and thorough application to all remaining interior wood-work of white-wash containing three ounces of the bi-chloride of mercury to twenty-five gallons. Where the animals have had the run of a yard, this should be thoroughly scraped, and sprinkled with lime, and the fence given a coat of the disinfectant white-wash. In cases where a stable can be burned, it is better to do so. In any case, if the stable can be abandoned for six months, it is advisable. Cattle may be placed in an infected stable without danger. In all the outbreaks I have had to deal with, I have put the above measures into effect, and have not had the disease reappear. In one instance, where it was impractical to disinfect, owing to there having been three badly-diseased animals penned in a small lot, the town, on my advice, quarantined the lot and built another fence around it eight feet distant from the old fence, thus preventing animals from becoming infected by contact with the old fence.

Glanders in Florida.—Although there can be little doubt that Florida has had her proportionate share of glanders in the past, this report deals only with those outbreaks which have occurred from the latter part of September, 1903, to the present time, January, 1905. During the Spanish-American war, when large numbers of army horses were brought into Florida, awaiting shipment to Cuba, glanders was prevalent in the army posts, and large numbers of the army horses were destroyed. So far as is known the disease did not spread from these infected centers, and it is probable, with the exception of the Tampa cases, that the disease was brought into the State by horse dealers. The first outbreak which came to the attention of the University authorities occurred at Zolfo, in De Soto county, in September, 1903. At the be-

ginning of the outbreak, the State Board of Health undertook to eradicate the disease, and employed Dr. N. B. Rhodes, of Tampa, to take charge of the work. At about the same time, I was directed to go to Zolfo to undertake the work under the authority vested in the Board of Trustees of the University by recent Act of the Legislature. Finding Dr. Rhodes already on the ground and that he had destroyed all visibly-affected animals and had tested a large number of suspects with mallein, I returned to the University believing the outbreak was under control.

On September 5th, the following telegram to the President of the Board of Trustees of the University was forwarded to the President of the University by Mr. J. R. Parrott, a member of the Board:

"Governor Jennings sends following wire to Mr. Wilson: 'Epidemic of glanders among horses threatened at Zolfo. Board of Health sent Dr. Rhodes, of Tampa, there some days ago, who has experienced complications which demand attention. Has advised that Chapter 5261 repeals Board of Health authority. Places responsibility on University. Kindly give matter attention, and oblige me. Mr. Wilson not expected back until early next week. Would advise you send our veterinarian to Zolfo at once. Have animals segregated where necessary, co-operating fully with State Board of Health, asking them to report facts back to you. Meeting should be called for organization under Act 5261 passed by last Legislature early in week as possible.'"

On September 9th I received the following telegram from Mr. Wilson relative to the same outbreak:

"Am informed that glanders appearing elsewhere. Governor thinks very important to adopt measures at any cost to stamp it out. He thinks it well to join Rhodes at Lakeland and co-operate at once, and after conference to order one hundred doses of mallein."

THE FIRST OUTBREAK AT TAMPA.—*En route* to the scene of the outbreak, I received a telegram from Dr. Rhodes to come on in to Tampa, as there was an outbreak at that point. As an outbreak of glanders in a city is of much more economic importance than one in a small settlement, I remained on the train till it reached Tampa at about midnight. The next day we visited a wood and lumber yard in the city, and discovered two cases of acute glanders. Both animals were immediately destroyed and buried in the city garbage trench. The remaining horses and mules, five in number, were tested with mallein and found free of the disease. The premises were thoroughly cleaned and disinfected and no new cases have since developed in that stable. Ow-

ing to a severe storm, I was delayed in leaving Tampa for several days. By the time I reached Zolfo the excitement of the people had abated, and, after testing all the animals in the vicinity that were exposed to the disease, I found no cases, showing Dr. Rhodes' work had been thoroughly performed. The news-paper accounts of the outbreak caused considerable excitement among stock owners in central Florida, and reports of suspicious cases came in in quick succession. In response to these, I visited Oxford, Anthony, Miami and Welborn, but found no trace of the disease. At Miami, however, there was reason to believe that a case had occurred.

THE LADY LAKE-CONANT OUTBREAK.—The three following letters from Lady Lake, under dates October 5th, 9th and 14th, 1903, are copied as being typical of those written by a close-observing layman and are presented with a view to instruction. They are as follows:

"I have been called to Mr. M.'s mill, near Conant, to some sick mules. Mr. M. bought a mule some time ago, at Leesburg, with some discharge from the nose. Since he bought the mule two more have taken it. They come in lumps as long as your hand, and legs swell. I have had them away from the rest of the mules since September 28th. Two have died and another one, I think, will get over it. If it is serious enough for the State to take hold of, please see about it, as we are very uneasy about the matter; or notify me what is best to do as soon as possible. Have them in a lot a quarter of a mile from the other stock. Don't know just what it is. Would be glad to hear from you. The discharge is a bloody mucus."

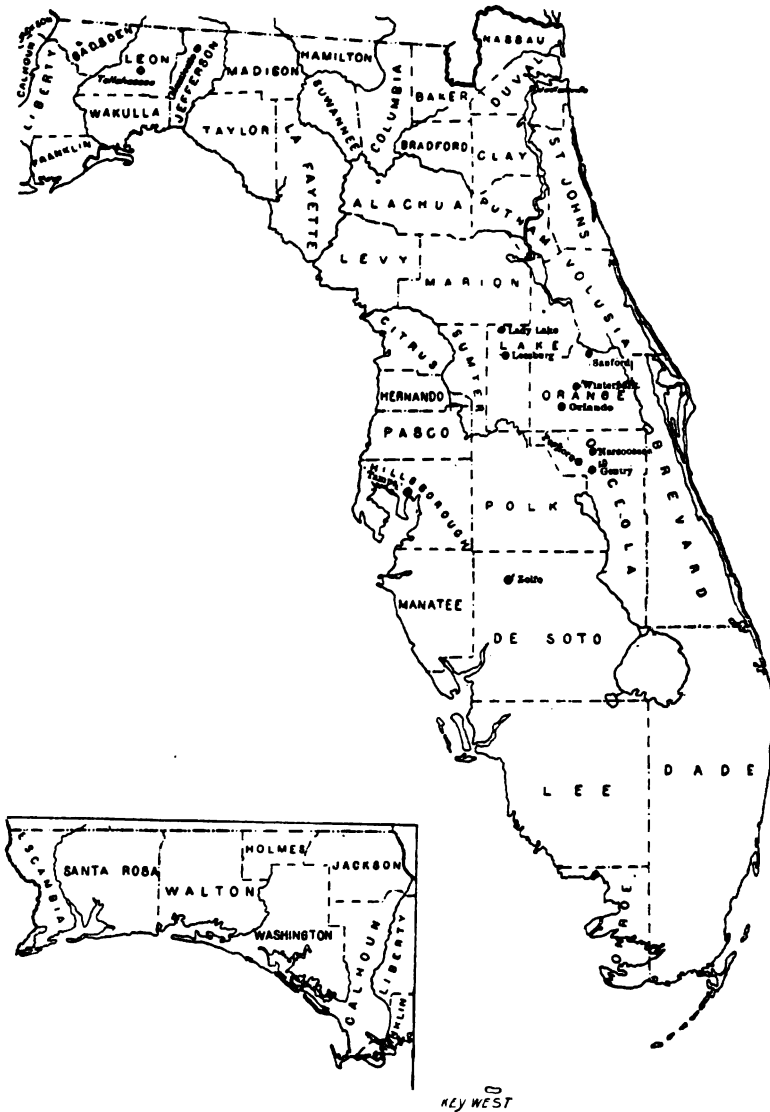
The same man wrote on October 9th:

"The mules that died broke out in sores on body, were swollen between the jaws, eyes sunken, sides drawn, breathing hard. The live one is eating better, discharges at nose smaller, breathing hard, but eats hearty and looks bright. I think it will get well. There are no more new cases. Did the State send a veterinarian to Leesburg some two months ago to examine cases similar to those that I have written about? If you decide to come, call at my house and I will give you all the information I can about the matter. If there are any more new cases I will notify you at once."

Under date of October 14th, he writes:

"There were two more new cases came in yesterday from the same stalls. There are now new stalls built. Your letter to me was very satisfactory, and we are now satisfied that it is glanders, according to your description. Your presence here would settle the matter, or a letter from you advising me what to do. If they get over it will it come back, or will they be all right? Apparently, one of the first ones will get over it."

PLATE NO. II.



On arriving at Lady Lake I found three badly affected mules. Fortunately for the mill owner, his veterinarian, though not a graduate, was a man of good judgment, and exercised it by building a new stable for the sick mules half a mile away from the mill, and placed the animals in it as soon as they showed signs of the (to him) new disease. I advised the immediate destruction and burial of the glandered animals. The infected run and shelter were to remain quarantined for six months. One of these mules, the first one which came down with the disease, was bought in Leesburg, where, subsequent events showed, he had infected the three livery stables in the town and caused the Leesburg outbreak. The loss at the Conant mills was five mules. The remainder, about twenty head, were all tested with mallein, but all proved themselves free of the disease. At the time of my visit the owner had, on the advice of the local veterinarian, discarded and closed up the old stable and had erected a new one.

THE LEESBURG OUTBREAK.—While at Conant I received a message from Leesburg to come to that town and investigate a disease in horses of the livery stables from which the mule that started the disease at Conant had been bought. I hired a team at Lady Lake and drove to Leesburg on October 20th. I found considerable uneasiness among the business men, as each of the three livery stables had lost an animal from the disease, and one of the stables still had four sick ones. One of these was kept in the yard at the owner's residence, while the other three were in a small lot at the edge of the town. Inspection showed them all suffering with acute glanders, all well-marked cases. As, by this time, news of the disease had spread into the surrounding country, the effect upon business was being felt, as persons from the country were afraid to drive their animals to the market. A meeting of the city council was called to discuss the matter, and, upon invitation, I addressed the body upon the subject of glanders. As a result, it was decided to double-fence the infected lot, which was practically in the center of the city, disinfect all drinking troughs, and to paint or white-wash all hitching posts and trees that had been used as hitching posts. Two of the stables had already been thoroughly cleaned and white-washed by the owners before my visit, and were in thorough sanitary condition. In the one where the disease had started, nothing had been done along the line of cleaning up. I condemned the four visibly-

diseased animals and tested four others, one of which reacted to mallein. The owner was informed that the reacting animal should also be destroyed. He seemed now to believe that I had determined to "put him out of business," and was prone to listen to the advice of a local physician who seemed to look upon me as an interloper invading his realm. The owner finally doubted that the disease was glanders, and even that I was the person I represented myself to be. It began to look as though the so-far peaceful prosecution of the work was to be interrupted. As I was not satisfied that the Legislature had given the University sufficient authority to compel owners to destroy animals, I informed the city officials that I considered my duty at an end and made preparations to depart. Public opinion at once crystalized powerfully against the stand taken by the owner of the animals, and he wisely had the four animals destroyed and his place disinfected according to my directions. The loss at Leesburg was three animals before my arrival, and four by condemnation. The original Leesburg case infected the mule that afterwards was sold to Conant, where he caused the death of four others, making the losses at Conant and Leesburg twelve head of horses and mules.

A CASE AT SANFORD.—On March 18th, 1904, I received two letters from Sanford pertaining to a diseased horse. One of these letters, written by Deputy-Sheriff Hand, stated he believed the disease to be glanders, and that it should be investigated, "in order that the people may know what to do." Upon arrival at Sanford, I found that Sheriff Hand had already quarantined the animal in a vacant lot at the edge of the town. I pronounced it a plain case of glanders, and advised its destruction at once. As the animal had always been regarded with suspicion since its arrival from Orlando, there had not been much chance of others becoming infected. However, I made a close physical inspection of all the animals it could have infected, but found no further evidence of the disease. I regard this horse as possibly being the original case in these outbreaks in central Florida. The animal came originally from Nebraska and was bought out of a drove at public sale in Orlando.

On June 3, 1903, the Governor of Florida approved "An Act to Provide for the Investigation of Diseases Among Domestic Animals, and to Prevent the Spread of Contagious Diseases Among Such." As this Act was not mandatory upon the part of

Board of Trustees of the University, but only "authorized and empowered" the Board to do certain things, it did not seem wise to involve the University in useless litigation. The University Board, also recognizing that the investigation and eradication of pestilential diseases more properly comes under the Board of Health, entered into an agreement with the State Board of Health, in May, 1904, through which the latter body assumes charge of the work, and pays all expenses incident to the same. Therefore, my authority to investigate and eradicate the following outbreaks, came from the Florida State Board of Health, of which I became the official veterinarian, by agreement between the two Boards.

My first detail to investigate an outbreak of glanders under the "Public Health Laws of Florida," is dated May 20th, 1904. It directs me to visit Monticello and vicinity, and to take such action as will effectively and speedily eradicate the disease, and to make a report thereon in writing to the office of the State Board of Health.

THE MONTICELLO CASE.—Upon arriving at Monticello, I found the public had become so interested in the matter that several leading citizens had, at their own expense, employed a competent veterinarian from a near-by town to visit the suspected animal. He had condemned it as being glandered, and advised burning the small stable and the carcass all at one time. This was done, and, of course, the disease was, so far as that animal and stable were concerned, completely checked. The history of the animal showed that there had not been much chance for the disease to spread, so I deemed it unnecessary to make mallein tests for other cases. There have been no other cases since, at that point.

THE SECOND TAMPA OUTBREAK.—On May 30th, the second detail directed me to proceed to Tampa to investigate a case of glanders in a horse on Taliaferro street, Ybor City, a suburb of Tampa. On reaching the place indicated I found a small horse, the property of a widow, which had been used for several years to deliver lunches to the cigar factories. The horse had been nursed by the cook, who had for some time cleaned the nostrils and farcy buds with her unprotected hands. The stall was in the back yard, about forty feet from the kitchen, and the animal had had the unrestricted range of the yard, which contained all

sorts of rubbish. The stall was small and filthy. The wood-work was liberally besmeared with the nasal discharges. The horse was immediately condemned and arrangements were made with the city sanitary officials for its destruction and burial in the city garbage trench. A sack was tied about the head to prevent the discharge from dropping on the streets, and the animal was led away and disposed of in the manner indicated above. Only one horse was known to have been in the yard, an animal which had been hired to replace the sick one. It was tested with mallein, but failed to react. The yard was thoroughly scraped with a hoe and all boxes and old lumber, etc., were burned. The harness was soaked in a bi-chloride solution, and the wagon shafts, etc., were washed down. The stall was thoroughly drenched first with 125 gallons of disinfectant, and later given a coat of white-wash with a brush, and by dashing it on from a cup into the corners and other inaccessible places. The disinfected manure was then hauled out to the garbage trench and buried.

THE WINTER PARK CASES.—On June 25th, Sheriff Vick, of Orange county, wired me that glanders was reported from Winter Park. On the same day I received a telegraphic detail to investigate the report from Winter Park.

I arrived at Winter Park in due time, and found that the sick animals were the property of the local liveryman. He had already lost one. The remaining visibly-affected one was found having the free range of the yard and all other stalls. There were four other animals in the yard. They all, sick and well, drank from a common tub, and no effort had been made to prevent the sick ones from visiting the stalls of the supposedly-healthy ones. The animal was condemned on sight, taken out, shot and buried outside of town. The stable and yard were disinfected after the plan already described. The four remaining animals were tested with mallein and three of the four reacted perfectly as the following statement shows: Their names were Barney, Frank, Charlie and Maud. Their normal temperatures were 99.9°, 99°, 101.2° and 100°, in the order named above. These temperatures were taken at 2 P. M. on June 28th. They were injected with Parke, Davis & Co.'s mallein at 4 P. M. the same day. At 8 A. M. the following day their temperatures were as follows: Barney's, 102.8°; Frank's, 103.5°; Charlie's, 104.6°; Maud's, 99.6°. The first three named also had hard, hot and

painful tumors at the point of injection. The lymphatic channels were plainly visible, radiating from the tumors. They were off their feed, and were dejected. Maud showed little or no tenderness and seemed in good spirits. She was removed from the bunch. At 11 A. M. their temperatures were again taken and were as follows, in the same order: Barney's, 103.6°; Frank's, 103°; Charlie's, 104°. As Maud showed absolutely no ill-effects of the injection, she was released to the owner for use. At 5 P. M., twenty-five hours after injection, the tumefactions had not decreased, nor had the animals' condition improved. Their temperatures were: Barney's, 103.6°; Frank's, 102°; Charlie's, 104.2°. The diagnosis was, therefore, glanders, and they were ordered destroyed, much to the regret of all concerned, as these horses and a few carriages represented the results of years of hard labor on the part of the unfortunate owner. A visit to the bunch at midnight, seven hours later, showed the horses still blowing and dejected, with little or no decrease in size of the swellings at the seat of the injection, nor any diminution in the tenderness in that region. The next day they were led out into the country, shot and buried; thus closing the most distressing incident which had thus far occurred.

In tracing up the outbreak, it appeared that the owner had bought the original case at a public sale of horses in or from Orlando about three months previously, or at about the same time the Nebraska horse was sold to parties in Sanford. My later information showed that the Winter Park horse was bought from a local dealer who purchased ten head of the Western horses at Orlando, and lost the other nine from glanders, which outbreaks are the next ones recorded.

THE NARCOOSSEE, PEGHORN AND LAKE GENTRY OUTBREAKS.—On July 23rd, a detail to investigate an outbreak of glanders in the vicinity of Kissimmee reached me, and I started at once for that point.

With the assistance and co-operation of Dr. E. G. Vans Agnew, of Kissimmee, I was enabled to locate the places where report said the disease existed. We located the first case, after a drive of fifteen miles, near Narcoossee. The owner was notified to destroy the animal, and did so in a day or two, with reluctance. His other horse was tested, but failed to react to mallein. This

was one of the ten head bought by the local dealer from the Western drove at Orlando.

At Peghorn we found another case, in possession of a man who had undertaken its cure for the local dealer. This was another of the ten head purchased at Orlando. According to the appearance of the nostrils, this case was the oldest-standing one I had seen. The nasal septum was perforated, sufficiently to run the fore-finger of the gloved hand through it, and thus lead the animal. The "doctor" who had undertaken his "cure," was surprised when this was done, as he had not discovered the perforation. The animal was destroyed and buried. As no animals had come in contact with this one, we spent no more time at Peghorn, and drove to Lake Gentry where we had heard the remaining ones, now seven in number, were. The dealer, whose settlement was in the woods, was glad to see us, but said our trip was useless, as all the horses had died. Owing to the remoteness of the place, there was little or no chance of the disease being spread, so we gave up further investigation of these outbreaks. Here ends the report of outbreaks that have occurred up to the present time.

There is no doubt in my mind that all the cases mentioned here had their origin in the bunch of horses brought from Nebraska to Orlando, excepting the Tampa cases and the case at Monticello. A glance at the accompanying map shows the proximity of the places where the outbreaks occurred, and the evidence gathered from various persons leaves no room for doubt. Even the Zolfo outbreak can be pretty clearly connected with the others, as the owner of the originally-affected Zolfo horse was at that time engaged in buying orange crops, and told me that his horse had been fed in the livery stables of every town of importance in central Florida.

Summing up the losses from the disease, including those destroyed by Dr. Rhodes, at Zolfo, we find that forty-one animals died as a result of being glandered, and that seven of these animals were destroyed upon the evidence of the mallein test. At a liberal estimate these animals were worth between five and six thousand dollars. Dr. Rhodes destroyed nine head at Zolfo, five of which were visibly glandered; the others reacted to mallein.

SHOULD A STATE PROTECT ITS LIVESTOCK INTERESTS?

As none of the parties who lost animals could be said to be responsible for the deaths, the question arises as to who is the responsible party. If the man who shipped the disease into Florida, did so knowingly, he should be held responsible. If he shipped in the disease, in ignorance of its existence, he was certainly not morally responsible. In all probability, it could not be proved that he knew he was shipping in glandered animals, hence he could not be held legally responsible and punished for it. A State has the right to protect its citizens against such impositions. It can do it in several ways; one of which is the reimbursement for the losses thus incurred by its citizens, and another is the supervision of the entry of animals within her borders. Ordinarily, the former method of protection would be the cheaper, as the inspection of animals at the State line would require the employment of two or more competent veterinarians at a fair salary. In such serious outbreaks as those which have occurred in the last year and a half, the losses would more than equal the expense of state-line inspection. A law which would make the shipper and dealer responsible, and revoke their license to do business in Florida, would soon put an end to the practice.

The complete eradication of the outbreaks cited in this report has been a source of gratification to the writer, because this result is not always attainable. I attribute the successful outcome of the work largely to the stand that the public has taken in favor of the extreme measures adopted, more than to our laws, which have not yet been tested in a court. Just how long owners will give their consent for animals that react to mallein, but which, to them, seem healthy and able to work, to be destroyed, I am unable to predict. I know that in several cases my directions would not have been complied with had not public opinion come to the rescue. It was difficult in some cases to get the owner to destroy animals that were plainly glandered, until public opinion forced action on his part.

In discussing the eradication of glanders by methods similar to those employed in the work in Florida, and the question of indemnity for animals so destroyed, Professor James Law, of Cornell University, says, in part:

"A law providing for the prompt destruction of every glandered soliped, and the safe disinfection of carcasses, stables, harness, vehicles, utensils, fodder, litter and manure that has been exposed to contamination, if enforced, would soon eradicate the disease. But this law should provide sufficient machinery for its enforcement, and, under suitable safeguards, an appropriate indemnity for the owner. With the use of mallein in all infected studs, as a diagnostic agent, the campaign can be made short, sharp and effective, instead of waiting, as in the past, for the slow development of occult cases.

"The greatest and most fundamental error in veterinary sanitary legislation is the lack of a guarded indemnity for the animals killed. I strongly urged this fact on the committee of the New York Legislature in 1898, but to no purpose. A bill was passed forbidding all indemnity for glandered horses, and an impetus thus given to the spread of the disease is daily bearing fruit, in our great cities especially, disastrous to the health of horses, and a constant menace to that of humanity as well. The law makes it the duty of veterinarians to report all cases of glanders, but in great horse establishments such a report would stop the use of the whole stable, at a loss of thousands of dollars per diem, and put a sudden end to the employment of the reporting practitioner by the firm or corporation in question. The owner of one or two horses can afford to report, as the loss of these, and their work, does not mean absolute ruin; but the owner of hundreds can not safely report. For owner and practitioner alike, the alternatives are presented of obedience to the law with personal ruin on the one hand, and the surreptitious dealing with cases of glanders and the preservation of their livelihood on the other. Whatever may be said as to the constitutionality of the law which destroys private property without compensation under the right of eminent domain, this is certain, that, as applied to animal plagues, this course is unjust, oppressive, and not only useless, but positively injurious, in that it drives the owners of animals to such courses as favor the spread of the plague in place of restricting it. To-day, in New York City, glanders is extensively prevalent, but large horse owners dare not adopt the legal measures for its extinction, with the certainty of great loss or ruin staring them in the face as the result. It should be further considered that any law is at once bad and vicious in its tendency which places before the citizen the alternatives of disobedience with profit, and obedience with loss or ruin. Such a law is the worst possible economy, because, in preserving the infection, it not only perpetuates the disease and its attendant losses for all time, but perpetuates forever the official expenses of keeping it in check, when a prompt extinction of the infection would once for all time abolish all loss and all outlay for its surveillance."

SOME LEGAL ASPECTS OF GLANDERS IN SOME OF THE STATES.

In reply to my request sent to every State Veterinarian or other Veterinary Sanitary Official of the various States of the Union, I have received a number of copies of live-stock laws

from which the following information relative to glanders is extracted:

Alabama:

The following letter from Dr. C. A. Cary explains itself:

"We have no law beyond a very indefinite one giving power to quarantine animals with dangerous infectious diseases, and making owners of such animals responsible for all damages resulting from or coming from their quarantined animals.

"I do believe it wise for each State to make some provision for paying an appraised value for horses and mules with glanders, when such disease has been unknowingly and accidentally contracted."

Arizona:

Paragraph from a letter received from Dr. J. C. Norton:

"Horses and mules condemned on account of glanders are not paid for by the Territory. In one case money was appropriated to pay for condemned stock by special act of Legislature,"

Arkansas:

"AN ACT TO PROTECT THE HORSE, MULE, JACK, AND JENNET OF THE STATE FROM CONTAGIOUS DISEASES.

"Be it enacted by the General Assembly of the State of Arkansas:

"IMPORTATION OF DISEASED STOCK PROHIBITED. *Section 1.* If any person or persons shall wilfully and knowingly drive or bring into this State any diseased horse, mule, jack, or jennet affected by the disease known as 'nasal gleet,' glanders or farcy or any other contagious or infectious disease, or shall drive or ship from one part of this State to another, unless it be to remove from one piece of land or ground to another piece of land of the same owner, or if any person shall knowingly sell any diseased horse, mule, jack, or jennet they shall be deemed guilty of a misdemeanor.

"PROHIBITED TERRITORY. *Sec. 2.* If any person shall bring into this State any Missouri or Western horses, mules, jacks, or jennets which have not been kept at least twelve months north of the northern boundary line of the State of Missouri and twelve months east of the west boundary line of the State of Iowa, he shall be deemed guilty of a misdemeanor: *Provided*, That nothing herein contained shall be construed to prevent or make unlawful the transportation of such horses, mules, jacks, and jennets through the State on railways, or prohibit driving through any part of this State or being in possession of said horses, mules, jacks, and jennets between the first day of April and the tenth day of July following: *Provided*, further, That this Act shall not apply to actual *bona-fide* persons moving into this State and bringing their horses, mules, jacks, and jennets with them.

"MISDEMEANOR, PENALTY. *Sec. 3.* Any person or persons, railroad company or owner of steamboats who shall violate any of the provisions of this Act shall be fined in any sum not to exceed three hundred nor less than one hundred dollars."

Colorado:

"SEC. 13. The said Board of Stock Inspection Commissioners may condemn diseased stock and cause the same to be killed, for which no compensation shall be paid."

My correspondent's opinion of the Colorado law is as follows:

"In marked portion you will see this Board has power to kill diseased stock without payment to owner. This, in my opinion, is a bad feature of our law, and tends toward the concealment and disposition of suspected animals without reporting to this Board, whereas, if owners were allowed a certain percentage of the actual value of the animal, they would be far more inclined to report such disease and thus help to stamp it out."

Florida:

"PUBLIC HEALTH LAWS.

"CHAPTER 4346.

"SANITARY NUISANCE ACT.

"An Act to define and declare what shall be deemed nuisances injurious to health and to provide for the removal thereof and punishment therefor.

"*Be it enacted by the Legislature of the State of Florida:*

"SECTION 1. A sanitary nuisance is hereby declared to be the commission of any act, by any individual, municipality, organization or corporation, or the keeping, maintaining, propagation, existence or permission of anything by an individual, municipality, organization or corporation, by which the health or life of an individual, or the health or lives of individuals, may be threatened or impaired, or by which, or through which, directly or indirectly, disease may be caused.

"SEC. 8. That any animal affected by glanders or other contagious or pestilential disease, kept in any part of the State of Florida, is hereby declared a nuisance injurious to health; and any person keeping or maintaining such nuisance who shall fail, after due notice from the State health officer, to abate the same, shall upon conviction be fined not less than five nor more than twenty-five dollars for every such offense.

"SEC. 15. This act shall take effect from its passage and approval by the Governor.

"Approved June 1, 1895.

"CHAPTER 4351.

"An Act to prohibit the introduction into this State and the sale therein of horses, mules, cattle, hogs, or other domestic animals which may be or are at the time of their introduction or sale suffering from diseases known as glanders, farcy, cholera, Texas fever or other virulent infectious or contagious diseases, or which were known at the time of such introduction or sale to have been in contact with any of such animals having had any of such diseases, and prescribing penalties for the violation of this act.

"*Be it enacted by the Legislature of the State of Florida:*

"SECTION 1. That hereafter it shall be unlawful for any person to bring into this State or to offer for sale therein any horses, mules, cattle, hogs, or other

domestic animals, knowing at the time of such introduction or offering for sale of any such animals that they are suffering from diseases known as glanders, farcy, cholera, Texas fever or other virulent, contagious or infectious diseases.

"SEC. 2. That any person who shall knowingly violate the first section of this act shall be guilty of a felony, and upon conviction thereof shall be imprisoned in the State penitentiary for a term of not less than two years or more than four years, or shall be fined in a sum of not less than five hundred dollars or more than one thousand dollars, or by both such fine and imprisonment.

"Approved May 25th, 1895."

Illinois:

The Board of Live Stock Commissioners pays, upon the certificate of the State Veterinarian, one-third of the appraised value, which may not be more than \$100.00 on each horse affected with glanders, provided the owner kills and disposes of the carcass according to law.

Kansas:

"SECTION 7437. *Pay for Animals.* When any animal or animals are killed under the provision of this act by order of the Commission, the owner thereof shall be paid therefor the appraised value as fixed by the appraisement hereinbefore provided for: *Provided*, the right of indemnity on account of animals killed by order of the Commission under the provisions of this act shall not extend to the owner of animals which have been brought into the State in a diseased condition, or from a State, country, territory or district in which the disease with which the animal is infected, or to which it has been exposed, exists. Nor shall any animal be paid for by the State which may be brought into the State in violation of any law or quarantine regulation thereof, or the owner of which shall have violated any of the provisions of this act or disregarded any rule, regulation or order of the Live Stock Sanitary Commission or any member thereof. Nor shall any animal be paid for by the State which came into the possession of the claimant with the claimant's knowledge that such animal was diseased or was suspected of being diseased. Nor shall any animal belonging to the United States be paid for by the State."

Kentucky:

"SECTION 47. *Glandered Animal to be Killed—Liability of Owner.* The owner of any horse, mule, jack, or jennet affected with glanders shall kill and cause such animal to be burned or buried, and failing to do so, shall be liable by civil action for all damages that may occur by the spreading of said disease.

"SEC. 47A. *Glandered Animal—Duty of Magistrate and Owner—Penalty.* When it is made to appear to the satisfaction of the county judge or any justice of the peace of any county in this Commonwealth that any animal within his county is diseased with glanders, it shall be the duty of the county judge or justice of the peace to notify the owner and require him to kill and bury it; and before the animal or animals are killed, the county judge, with a justice of the peace, or two justices of the peace, shall cause the animal to be valued, the valuation not to exceed fifty dollars for any one animal, and the valuation of said

animal or animals, together with the fact of its destruction, shall be certified by the two justices or the county judge to the county court, together with the name of the owner, and spread upon the records of the court. A certified copy of said order, under the seal of the county, shall be delivered to the owner, and upon its presentation to the county court, the county judge may order the amount certified to be paid out of the county funds in which county said disease appears; *provided, further*, That if the animal is diseased with glanders and the owner should refuse to destroy the animal on the demand of the county judge, or any justice, he shall be subject to a fine of not less than one hundred dollars nor more than five hundred dollars, to be enforced by indictment, etc.

"All acts and parts of acts in conflict with this section are hereby repealed. (This section is an act of April 29, 1897.)

"SEC. 1332. *Stock Affected with Glanders to be Killed.* It shall be the duty of any person owning a horse, mule, jack, or jennet affected with glanders to kill such animal, and cause the same to be either burned or buried; and if he fail to do so he shall be fined not less than twenty nor more than one hundred dollars.

"SEC. 1333. *Permitting Glandered Stock to run at Large.* If any person owning or having charge of a horse, mule, jack, or jennet affected with glanders shall knowingly permit such animal to run at large on his own premises, so as to come in contact with animals belonging to others, and thereby spread the disease, or suffer such diseased animal to go upon the public highway, or shall sell or trade, convey or transfer, by gift or otherwise, an animal so diseased, he shall be fined not less than twenty nor more than five hundred dollars."

Maine:

Pays one-half the appraised value up to \$100.00 appraisement on registered animals, and up to \$50.00 appraisement on common stock, for animals that have been in the State three years.

Maryland:

Pays \$10.00 for the animal and \$10.00 are allowed the owner for burying the carcass and cleaning up and disinfecting the stable.

Massachusetts:

The following was received from the Chief of Cattle Bureau:

"I send you under separate cover a copy of the laws of Massachusetts relating to contagious diseases among domestic animals. You will see under section 6, of chapter 90, that animals suffering with a contagious disease may be ordered killed without appraisal or payment, if the public good seems to require it, the only exception being that cattle killed because of tuberculosis are paid for by the State, not over forty dollars to be paid for any one animal.

"The State does not allow anything for horses and mules that are killed because they have glanders or farcy, for the reason that the Legislature has always taken the ground that an animal so diseased was of no value, as no one would care to own such an animal, and no one would knowingly purchase such an animal for his own use. Therefore, the property being valueless, it is destroyed without the State allowing anything for it."

Mississippi:

Requires the destruction of glandered animals, but pays no stated indemnity. In one case the Legislature, by special enactment, paid for a lot of glandered animals that had been destroyed by the State authorities.

Missouri:

The county court appraises value of the animal after it has been quarantined. It is killed by the sheriff, and burned or buried by the owner, who can then appear before the court and ask for indemnity.

New Jersey:

The following was received from the Secretary of the State Board of Health:

"In accordance with the request contained in your letter of July 13th, we forward to you a copy of Circular 94, containing the laws of New Jersey relating to infectious diseases of animals.

"You will observe that no compensation is allowed in this State to owners of animals affected with glanders, anthrax, etc., in cases where the diseased animal is destroyed. One of the legal advisers of this Board has taken the position that animals affected with incurable diseases, which are liable to be transmitted to human beings, should be dealt with in the same manner that other nuisances, endangering the lives and health of human beings, are dealt with, that is to say, they should be destroyed without compensation to the owner. This rule holds good with reference to houses which are pulled down to prevent the spread of a great conflagration, and seems to be justified on the score of public necessity. A departure from this principal has been made in the case of bovine tuberculosis, an allowance being made to the owners of cattle found to be affected with this disease and slaughtered by order from an authorized officer of the State."

North Dakota:

The following was received from the State Veterinarian:

"In reply to your favor of the 20th inst., I wish to say that our State laws bearing upon glanders are not available in pamphlet form. As a matter of information, however, I wish to say that all horses affected with glanders are destroyed by order of our district veterinarians, but the owners are not reimbursed for their loss. I will, however, venture the opinion that a reimbursement, however small, would facilitate eradication of glanders very greatly, as under its operation owners will not be as apt to conceal the disease as they are at the present time. In a bill which I propose to bring before our Legislature next winter, I propose to make some provision for reimbursement."

Ohio:

"SEC. 4211-16 (of the Revised Statutes). *Appraisalment and Killing of Diseased Animals.* When in the opinion of the Commissioners it shall be necessary to prevent the further spread of any dangerous, contagious or infectious dis-

ease among the live stock of the State, to destroy animals affected with or which have been exposed to any such disease, it shall determine what animals shall be killed, and shall appraise or cause the same to be appraised, by disinterested citizens, as hereinafter provided, and cause such animals to be killed, and their carcasses to be disposed of as in the judgment of the Commission will best protect the health of the domestic animals of the locality; *provided*, that no animal shall * * * be slaughtered under the provisions of this act unless first examined by a competent veterinarian in the employ of the Commission, and the disease with which it is affected or to which it has been exposed adjudged to be a dangerous and contagious malady."

From the Second Annual Report of the Ohio State Board of Live Stock Commissioners, for 1903, the following regarding glanders is copied:

"Glanders is the most dangerous and fatal disease of the horse and, at the same time, it occurs in all other domesticated animals, with the possible exception of the ox, and is not infrequently the cause of a horrible death in human beings.

"For these reasons the control of this disease among horses, with a view to its ultimate extirpation, is a very important duty of the Board.

"Although the direct cause of the disease is a specific germ, it is a marked fact that poor hygienic conditions are important factors in the development, as well as in the spread of glanders. Such conditions are naturally found chiefly among such owners of horses as can ill afford to lose them, when the destruction of animals, in the incipient stage of the disease becomes necessary for the protection of the community in general.

"The compulsory destruction of animals, in these cases, is a hardship on some people that may, in some cases, considerably affect the efficiency of the work of the Board where voluntary information from the public constitutes the basis of the investigations that are made.

"As required by law, and in view of the above explanations, the State Board of Live Stock Commissioners hereby reports for your favorable consideration, the claim of three thousand and twenty dollars (\$3,020.00) against the State of Ohio, as compensation for horses affected with glanders and destroyed by order of the Board; this being the appraised value of thirty-three horses as itemized above.

"While writing this report, an investigation of an outbreak of glanders is being conducted in the vicinity of Feesburg and other points in Brown county. From present indications it is safe to assume that a number of affected animals will be found; in fact, the horse that belonged to J. W. Trout, and which is included in the above list, is one of a group of suspected animals that were exposed to three horses affected with acute glanders, and which were destroyed by their owners when advised to do so, by a local veterinarian. These facts make it seem desirable that the Board have at its disposal a limited fund for the purpose of paying to the unfortunate owners of horses afflicted with glanders, at least a partial compensation for their loss. This would, in many ways, facilitate the work of the Board and thus increase its usefulness.

"It is respectfully recommended that the sum of three thousand dollars (\$3,000.00) be appropriated for this purpose, by the Legislature."

Oklahoma:

The following was received from the Secretary of the Oklahoma Live Stock Sanitary Commission:

"Your communication of the 15th inst. has been referred to this office for reply, and in answer I will quote section 14, chapter 31, of the Statutes of Oklahoma for 1897, governing inspection and disposition of equine stock. I also enclose copy of our Quarantine proclamation governing the movement of stock to and within the Territory of Oklahoma. I will further add that as the law requires the Sanitary Board to audit all claims for diseased stock killed, we have taken this stand: that a horse affected with glanders, or *maladie du coit*, is practically worthless, and do not allow to exceed \$10.00 for any such horse destroyed.

"Section 14 is as follows:

"SECTION 14. Whenever any live stock within this Territory shall be found by the Live Stock Inspectors to be affected with rinderpest, foot-and-mouth disease, glanders, *maladie du coit*, or contagious pleuro-pneumonia, he shall summon three disinterested householders and cause said stock so affected to be appraised, which appraisement shall be upon the value of the stock at that time. He shall then kill said stock, and dispose of the carcasses thereof in such manner as will, in his judgment, best protect the health of the domestic animals of that locality. The Inspector shall forward his report of animals killed, disease with which affected, name of owner, and the appraiser's certificate to the secretary of the Live Stock Sanitary Commission. The said Commission shall audit the account, if correct, and forward the voucher to the Auditor of the Territory, who shall draw his warrant upon the Territorial Treasurer for the amount, and who shall pay the same out of the general funds of said Territory. *Provided, however,* That if said stock contracted the disease from without the Territory, or if the owner thereof has violated any quarantine regulations of the Territory, or of the United States Government, or if he became the owner thereof with the knowledge that said stock was affected with said disease, the Territory shall not be liable for the value thereof."

Oregon:

The State Veterinarian of Oregon sent the following reply:

"Our law reads, that in case of a supposed contagious or infectious disease arising in any locality, the Stock Inspector of that county shall be sent for, and, if he is not satisfied with the case, he shall send for the State Veterinarian, who shall go at once, and, if he finds a contagious or infectious disease present, he shall quarantine the same and report to the Board of Oregon Domestic Animal Commissioners, who, in turn, will have the animal killed and a warrant drawn upon the State Treasurer for the appraisal amount and the owner paid."

Pennsylvania:

The section of the law under which the Pennsylvania State Live Stock Sanitary Board operates, in part says, when dealing with glanders:

"SECTION 3. That when it shall be deemed necessary to condemn and kill any animal or animals to prevent the further spread of disease, and an agreement cannot be made with the owners for the value thereof, three appraisers shall be appointed, one by the owner, one by the Commission or its authorized agent, and the third by the two so appointed, who shall, under oath or affirma-

tion, appraise the animal or animals, taking into consideration their actual value and condition at the time of appraisal, and such appraised price shall be paid in the same manner as other expenses under this act are provided for; *Provided*, That under such appraisal not more than twenty-five dollars shall be paid for any infected animal of grade or common stock, and not more than fifty dollars for any infected animal of registered stock, nor more than forty dollars for any horse or mule of common or grade stock and not to exceed fifty per cent. of the appraised value of any standard bred, registered or imported horses."

Texas:

A member of the Texas Live Stock Sanitary Commission writes as follows:

"Replying to your inquiry regarding the reimbursing of owners of infected domestic stock that are killed by reason of such infection, will say: Under our law the owner or person in charge of horses, who suspects or believes or is informed that such horse or horses are affected with glanders, shall report same to the sheriff of his county, and the county judge shall thereupon appoint three persons to examine such animals, and, if found with glanders, the same shall be killed and the County Commissioners' Court shall allow as compensation for such animal the value as appraised by the said committee appointed by the county judge as aforesaid. Since this Commission was organized we generally send the veterinarian of our Commission to examine and determine disease, and, if found with glanders, he orders it killed, and the owner can then file his claim with the Commissioners' Court of his county for allowance, and if the court is not satisfied with the same they allow what they think is right.

"It is my opinion, based on experience and observation, that each county should pay a just and fair sum for the animals killed (by authority). Where this is not done the parties will hide the matter from the officers and neighbors until they can sell or trade the animal off to some traveler, who then scatters the disease."

Wisconsin:

The following is copied from "The Veterinary Laws" of Wisconsin:

"In case of an infectious or contagious disease of a malignant or fatal nature, such as rinderpest, foot-and-mouth disease, pleuro-pneumonia, anthrax and Texas fever among bovines, glanders among equines, anthrax in sheep, and other diseases of a like nature or fatal tendency shall become or there is good reason to believe that either of them will become prevalent in the community in which any such disease exists the State Veterinarian may, if in his judgment it shall be necessary, order any diseased animal or animals or any which have been exposed to an infectious or contagious disease to be slaughtered. In making appraisalment of a diseased animal the appraisers shall determine its value in the condition in which it is at that time; but the appraised value of a horse afflicted with glanders shall in no case exceed fifty dollars. The slaughter of animals which have been so appraised shall be made under the direction of the local health officer or chairman of the board.

"All claims against the State arising from the slaughter of animals as above provided shall be made by filing with the Secretary of State a copy of the State Veterinarian's notice to the justice of the peace and the return of the appraisers to the justice, which notice and return shall be certified by him. The Secretary of State shall examine these, and if satisfied that the amount awarded is just and that the owner of the animals slaughtered is entitled to indemnity, shall issue his warrant for two-thirds of the sum named in such return; but if he shall have reason to believe that the appraised value is greater than the real value of such animals he shall pay such owner such less sum as he shall deem just; *provided*, that the right to indemnity shall not exist nor shall payment be made in either of the following cases:

"1. For animals owned by the United States, this State, or any county, city, town or village in this State.

"2. For animals brought into this State contrary to the provisions of section 1491 or the preceding section, or where the owner of the animal or person claiming compensation has failed to comply with the provisions of section 1492b or of the preceding section.

"3. When the owner or claimant, at the time of coming into possession of the animal, knew it to be afflicted with a contagious or infectious disease.

"4. When the animal slaughtered was diseased at the time of its arrival in this State.

"5. When the owner shall have been guilty of negligence or has wilfully exposed such animal to the influence of a contagious or infectious disease."

Cuba:

The following, though dated March, 1901, may yet be in force, as it was received in September, 1904:

"HEADQUARTERS DEPARTMENT OF CUBA.

"HAVANA, March 6, 1901.

"The Military Governor of Cuba, upon the recommendation of the Secretary of State and Government, directs the publication of the following regulations for the information and guidance of all concerned.

"J. B. HICKEY,

"Assistant Adjutant General.

"GENERAL RULES FOR THE PROPHYLAXIS OF THE GLANDERS AND TUBERCULOSIS IN THE CITY AND PROVINCE OF HAVANA.

"First—From the publication of these Regulations in the *Official Gazette*, the Commission appointed by Order No. 52, from these Headquarters, dated February 11th, of the present year, shall be the competent authority to finally decide without appeal, all cases and questions relating to glanders and tuberculosis in cattle, and the Boards of Health, sanitary employees and organizations of Havana, municipal as well as provincial, shall be under the direction of the aforementioned Special Commission.

"Second—The inspection of the stables for all kind of cattle existing in the city of Havana and of the ranches situated in the province of the same name, shall be made by order and under the direction of the Commission; said Com-

mission shall name the necessary personnel for the strict compliance with these duties.

"Third—Stables for all kinds of cattle and industrial establishments using horses or mules, shall be obliged to employ a veterinary surgeon who shall be accountable for the sanitary condition of the cattle.

"Fourth—All horses having nasal discharges or cutaneous ulcers, shall be considered as being glanders suspects, and shall be placed at the disposal of the Commission or its delegates, until the disease is properly diagnosed.

"Fifth—The same methods shall be observed with the milch cows which may be suspected to be suffering from tuberculosis.

"Sixth—On the confirmation of the diagnosis made by the veterinary surgeons appointed by the Commission of existence of glanders or tuberculosis in an animal, the same shall be immediately killed and cremated.

"Seventh—In the case mentioned in the preceding article, the owners shall be paid one-half of the amount at which the Commission or its delegates may have valued the animal killed; it being understood that only those willingly presenting animals which may be suspects or are actually suffering from those diseases, shall be entitled to said indemnity.

"Eighth—Those persons having in their stables, industrial establishments, rural properties or private residences, animals suspected or actually suffering from the said diseases shall be fined from \$10 to \$100 United States currency, at the discretion of the Commission. These fines shall be paid by the owners of animals and the veterinary surgeons professionally in charge of said animals, each paying one-half of the amount of the fine.

"Ninth—A period of eight days, from the publication of these rules and regulations, will be granted to those owning or having horses, mules or neat cattle of any kind, or goats, in the city of Havana, within which to report the sanitary condition of their animals, said report to be certified to by a veterinary surgeon. At the end of said period a register will be opened at the offices of the Commission, where such animals as may be considered to be in good healthy condition shall be registered.

"Tenth—The owners of stables of all kinds shall not bring into their places any new animal without first announcing the fact to the Commission for the purpose of the proper inscription of such animal, under a penalty of from \$10 to \$100, at the discretion of the Commission, the owners also being obliged, under the same penalty, to report the deaths and removal of the animals.

"Eleventh—The owners of stables of all kinds shall also be obliged to report the number of animals they may have at pasture, as well as to state the causes of their being pastured, giving the name of the property at which the animals may be found.

"Twelfth—The same penalty specified in the tenth rule shall be imposed upon the owners of country property, who may take to pasture therein, horses suffering from glanders and cows suffering from tuberculosis; unless, within eight days from the publication of this rule, they give notice to the Commission of animals suspected of, and actually suffering from said diseases; and within twenty-four hours of diseases or suspected cases that may occur thereafter.

"Thirteenth—It shall be the duty of the rural guards to demand the sanitary certificate of any animal whatsoever that may be sent to pasture, which certificate shall be issued by the Commission.

"Fourteenth—All persons giving notice to this board of the existence of an animal suffering from glanders, or of any cow suffering from tuberculosis, shall receive a compensation of \$5, United States currency, provided that said cases be confirmed.

"Fifteenth—All expenses whatsoever incurred by this Commission shall be charged to the State, and the services thereof shall be absolutely free to the owners of animals.

"Sixteenth—The maximum price to be paid for such animals as may be killed shall be \$200, United States currency, for each horse, and \$75 for each cow.

"Seventeenth—All owners of stables having horses or cows shall conspicuously post these rules in their establishment."

THE MATTER OF INDEMNITY IN OTHER STATES.

The matter of indemnity for condemned animals is, in many States, left to the discretion of the Live Stock Sanitary Boards. In many States the law only provides paying for cattle destroyed because of their being afflicted with tuberculosis, or consumption. In several States it is specifically stated in the Live-Stock Laws that no indemnity will be paid for glandered animals destroyed by sanitary officials. The views held by many in regard to indemnities for glandered animals are expressed in the following:

"This State does not indemnify owners for animals destroyed because of communicable diseases.

"It is not good policy to indemnify owners in one State, unless the surrounding States do the same; for the reason that diseased animals are brought into the State paying the indemnity from the States that pay no indemnity. When a Territory, Dakota (this was before division) indemnified the owners of animals destroyed because of communicable diseases, the Territory became the 'dumping ground' of glandered horses from the surrounding States."

The following publications of the Florida Experiment Station are available for free distribution, and may be secured by addressing the director of the Experiment Station, University of Florida, Lake City, Fla.:

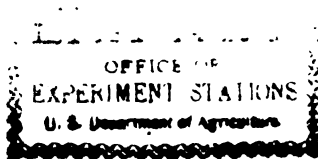
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BULLETIN No. 78.

MARCH, 1905

• FLORIDA •

UNIV. OF FLA.

JAN 2 1905

AGRICULTURAL EXPERIMENT STATION.

FORAGE CROPS.

THE SILO.



BY CHAS. M. CONNER

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

St. Augustine, Fla. :
THE RECORD COMPANY.
1905.

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FORAGE CROPS.

BY CHAS. M. CONNER.

The awakened interest in live stock and dairying has given rise to numerous inquiries (coming to this office) regarding forage crops. As no publications are available on this subject, it is thought best to give such information as has been collected. The investigations are to be continued, and a subsequent and more complete report made later. These reports will of necessity be brief on account of the short time these crops have been under observation.

SORGHUM.

While this plant is best adapted to the Central West on account of its drouth-resisting properties, it has long been a favorite in the South as a forage crop. There are two kinds of sorghum. The saccharine and non-saccharine. Both are drouth-resistant, but the latter is used more for its seed than for forage. The non-saccharines are known as chicken corn, Jerusalem corn, milo maize, etc. They are not used very extensively in this State. The common sorghum is used in the North and west for making syrup, and also as a forage crop. In this State it is used principally as a forage crop. The sugar cane supplies better syrup.

VARIETIES.

There are several varieties of the common sorghum grown for forage, and are given in order for their maturity:

Early Amber,
Early Orange,
Coleman,
Link's Hybrid,

the first maturing in about ninety days, and the latter in about 120 or 130 days. The early amber is best suited for our purposes.

TIME TO PLANT.

Planting can be done any time from early spring up to August 1st, but it is better to plant early and cut the second time

for late feeding. Only one variety need be used, if planted at different times, to insure a succession of crops.

SEEDBED.

When possible, it is well to have a crop of cow peas or velvet beans precede this crop. Plow the ground thoroughly and as deeply as the subsoil will allow, run a cutaway harrow over the ground and throw up light beds. Open the beds and apply the fertilizer.

FERTILIZER.

This plant is known as a gross feeder, and requires a considerable amount of potash, as well as nitrogen and phosphoric acid. Use from 600 to 1,200 pounds of fertilizer containing Ammonia 1 per cent, Potash 8 per cent, Phosphoric Acid 6 per cent. Use cotton-seed meal as a source of ammonia. Apply in row and work in with a plow. Throw up low beds and brush down with a light drag or weeder. Let stand about ten days before planting. Plant with a drill at the rate of 13 to 14 quarts of seed per acre. It is better that the seed be put in with a drill as the rows are close and straight and can be cleaned with a plow, thus avoiding hoeing. Leave the plants thick in the row; an average of about two stalks per inch. If the ground is rich and well manured they can be left thicker. If very poor, leave one stalk every three or four inches.

CULTIVATION.

Cultivate as soon as possible in order to keep down weeds and grass. The weeder can be used as soon as plants are three inches high.

USE.

As soon as the plants get four or five feet high you can begin feeding. Cut and haul out to stock. As soon as a large enough area is cut over, throw the dirt from the rows and apply about 300 pounds of cotton-seed meal per acre, and throw the dirt back again. This will make the second crop grow better.

If a large number of dairy cows are to be fed, it pays to run the sorghum through a cutting box, but if only a few, it can be thrown on a grassy place and they will eat it up clean.

If the cattle and hogs are both to be fed, it will be found



SORGHUM



Pigs Feeding on Sorghum

advantageous to feed together. The cattle will eat the tender parts and the hogs will chew up the tough parts of the stalks.

During the past summer, the work stock (horses and mules) were fed for six months on sorghum. Young pigs made a fairly good growth on sorghum alone from June 30th to September 21st.

When fed alone, sorghum contains rather too much water for most stock. The feeding value increases up to the period of ripening, reaching its maximum when the seed are ripe. The following is the analysis of the ripe stalk:

DRY MATTER	PROTEIN	CARBOHYDRATES	ETHER EXTRACT
20.6 per cent.	0.6 per cent.	12.2 per cent.	0.4 per cent.

This plant is used for silage in most dairy sections. It makes rather sour silage, but if put in the silo when rather ripe, it is relished by stock.

Sorghum stands the spring drouth better than any other crop, yet it responds to irrigation, as is evidenced by the following figures:

Yield of green sorghum on high, dry sandy soil averages two plots 19,605 pounds per acre, cut September 12th.

Yield of green sorghum, irrigated three times during the dry season in the spring:

First cutting, June 22d.....37,740 pounds.

Second cutting, August 4th....13,600 pounds.

Total.....51,340 pounds.

The crop can be cut and put in shocks, where it will dry out, then can be stored in a barn and fed during the winter.

SECOND GROWTH SORGHUM.

Numerous newspaper reports are given regarding the poisonous effect of second growth sorghum. These come mostly from the West and Northwest. Very few cases have been reported from the South. The Nebraska station reports the presence of prussic acid in second growth sorghum during a severe drouth. In Florida the second crop would come during the rainy season, hence there would be little danger of poison. We have never had a case at this station.

RAPE.

This plant resembles the rutabaga when growing, except that it does not have a fleshy root. It is becoming quite popular in some sections of the State. The mistake has been made of planting it in the spring. Like the cabbage, it does best in the winter. It should be planted in September or October. There are several varieties, but the Dwarf Essex is the most commonly grown.

USE.

It makes excellent feed for hogs or sheep. To get the best results the stock should be turned in and allowed to graze it down. Cattle or horses mash it down, and are most likely to bloat.

It contains a large amount of water, and should be supplemented with corn or something concentrated, if the animals are to be fattened rapidly.

When milch cows are fed on this there is danger of tainting the milk, unless fed just after milking.

It can be grown in the fall and winter when other crops are out of the way.

The following is the composition of rape:

DRY MATTER	PROTEIN	CARBOHYDRATES	ETHER EXTRACT
14 per cent.	1.5 per cent.	8.1 per cent.	0.2 per cent.

It is practically the same composition as cabbage.

PLANTING.

The ground should be well prepared, and rows laid off two and one-half feet apart. Apply fertilizer at the rate of 400 to 600 pounds per sack, containing ammonia 4 per cent, phosphoric acid 7 per cent, and potash 8 per cent. Work in well, and plant with a drill at the rate of 4 to 6 pounds of seed per acre (seed costs 10 cents per pound.)

Rape gave a yield of 27,200 pounds on rather light sandy soil, well manured. This crop followed the sorghum mentioned above on the irrigated land, and this makes a total yield of 78,540 pounds, or a little over thirty-nine tons of green feed per acre, in less than twelve months.

It requires one or two workings with a light plow to keep the grass and weeds down.

As soon as it gets six or eight inches high, hogs or sheep or young calves may be turned in on it to graze. If you should cut the crop for feeding, cut above the ground and the stems will sprout and produce another crop.



DWARF ESSEX RAPE



TEOSINTE.

This plant is a native of South America. It has some merit as a forage crop, but is not so good as sorghum. If allowed to mature, it has too much woody fibre. It matured seed at the station last year, but the season was very favorable. The seed is rather expensive, and must be purchased each year, while sorghum seed can be raised on the farm.

This plant gave a yield, on fairly rich ground, of 20,000 pounds of green stuff per acre. It was cut October 26th. If it had been cut several times during the summer, the yield would have been much greater. At the Louisiana station a yield of fifty tons per acre was obtained.

It is a gross feeder, and requires about the same fertilizer as given for sorghum.

Plant in rows five feet apart and three feet in the row. Plant three or four seed per hill.

RYE.

Rye is used principally as a winter pasture crop. Sown in November, it will make an excellent pasture all winter. Care should be taken to get Florida grown seed, as seed from the North does not do well. Use five or six pecks of seed per acre. Prepare the ground well by breaking, and smooth down the ground with some kind of drag. If fertilizers are to be used, use stable manure, if it can be had. If not, use a fertilizer containing

- 3 per cent Ammonia,
- 6 per cent Potash,
- 6 per cent Phosphoric acid.

Use from 300 to 600 pounds per acre, according to soil. If grown for seed, do not use so much ammonia.



RYE planted in drills

If the crop is to be cut and fed, it should be planted in rows two feet apart and very thickly, using, say, a handful of seed to two steps. Use plenty of fertilizer and cover lightly. This can be cut two or three times. Commence using as soon as high enough to cut.

PARA GRASS.

Panicum Molle.

This giant grass is well suited to this State as a pasture grass, and also as a hay grass. Like its relative, the crab grass, it takes root at every joint, if touching the ground, but if thick enough on the ground, will stand well up, as shown in the cut herewith. If allowed to stand too long the lower stems become hard and woody. It should be pastured or cut frequently for hay. It grows rapidly, making a growth of 4 or 5 feet in 60 or 70 days.

This grass has been tried at various places in the State, and pronounced a failure, on account of the way it was handled.

It does not mature seed here in sufficient quantities to warrant an attempt to propagate it in this way.

The best way to secure a stand is to obtain enough of the grass to put out one piece to every square foot of ground. This can be done by laying one piece (8 or 10 inches long) one foot apart on the right-hand side of the furrow as the ground is being plowed. So place the pieces that the end will project two or three inches after the next furrow has been turned. The best time to do this is just before the rainy season begins.

Low, moist soil is the best, but it will do well on rather sandy soil.

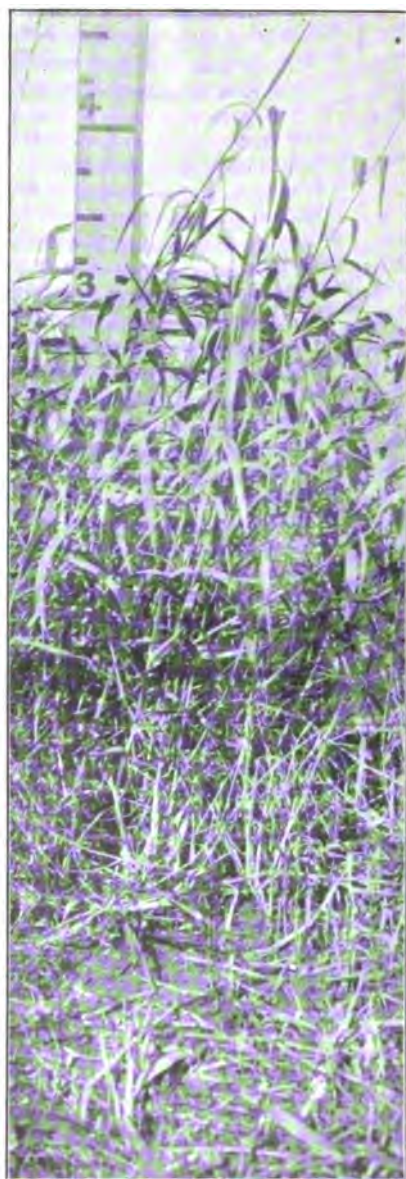
It is very similar to crab grass in its requirements, and responds to fertilizer and moisture in about the same way.

Under favorable conditions the para grass will grow stems 18 to 20 feet long.

No feeding test has as yet been made, but will be taken up as soon as a sufficient quantity of hay can be secured.



PARA GRASS, set out June 20th



Growth of Para Grass after first cutting, taken October 25th

THE SILO.

Some doubt has been expressed by feeders of this State as to the success of the silo in this warm climate. There are a number in use in the State, and all very successfully. Some have advocated that they should be built below the ground. This is not necessary. The silo at the station is a stave silo, and all above the ground. It keeps perfectly.

The silo is not essential to successful stock feeding in Florida, but it will tide the feeder over the dry seasons, be he engaged in dairying or the raising of beef cattle. During the season of hay making it is usually rainy, and the hay cannot be saved with ease. In filling the silo the rain does not interfere, as we frequently wet the silage as it goes in.

Putting green feed up in the silo does not increase its feeding value. The silo simply enables you to save your feed regardless of the rain, and keeps the feed in a palatable form. A larger amount of feed can be grown per acre where silage crops are grown, as compared with hay grown on the same land.

The following crops are suggested for filling the silo:

Corn with cowpeas, planted at the same time so the vines will run up the stalks, and can be cut with the corn. This mixture makes excellent feed.

Sorghum with cowpeas. Sorghum should be ripe when cut. Teosinte.

Cowpeas alone may be used, but they are very difficult to run through the cutter.

Velvet beans do not make good silage, unless mixed with corn or sorghum.

A field planted for silage should be as near the silo as possible so there would be as little hauling as possible.

KIND OF SILO.

There are a number of kinds of silos, and are built either round or rectangular. The round is perhaps the best. They are sometimes built of brick and cement, but more commonly of wood. When built of wood they are built by standing 2x4

pieces around a circle of the desired size, and binding them together by nailing one-half inch boards on the inside. The boards bend easily and act as hoops. These boards are covered with heavy building paper and ceiling nailed on so that the wall is air-



THE SILO

tight. The walls may also be made air-tight with plastering, first nailing on something to hold the plastering.

Perhaps the cheapest form of silo is the stave silo. The staves should be long enough to reach the top without splicing. Cypress timber is the best to use. Hard pine will do, but it is

not as easy to make air-tight. The staves should be dressed on the inside, and should be sized so that they will fit up and the silo will be the same size at the top as the bottom. This is essential, as the silage will settle for some time after the silo is filled, and if the silo is not the same size it will let air in between the walls of the silo and silage.

The staves may be from 4 to 6 inches wide, but should be 2 inches thick. It is best to have them cut 6 inches wide and sized to 5 inches. The edges should not be beveled for a silo 10 feet in diameter or larger.

Flat or round hoops may be used. Use two lugs, one on each side, and the staves will draw together better. Place the hoops rather close together at the bottom and increase space as height increases. The cut shown herewith illustrates how the hoops may be placed.

DOORS.

The doors should be 18x24 inches, and cut on bevel so that when placed in position from the inside the pressure of the silage will tend to make the cracks air-tight. Have about three doors. Do not place one above the other, as the silo will keep its shape better. Place first door 5 feet from bottom, the next 10 feet, and the third 15 or 16 feet. A door may be made in the roof for filling.

FOUNDATION.

The foundation should be made of brick or stone. As a silo should be made as high as possible, some prefer to dig 3 or 4 feet in the ground, thus increasing its capacity. This cannot be done unless the drainage is good, as water will spoil the silage if allowed to stand on it. The wall should be at least one foot thick, and level on top.

Should the rats bother by digging under, the bottom may be cemented.

ROOF.

The roof can be made by ripping a 12 or 14-inch plank diagonally, the sharp points going to the center. Any desired pitch can be given. It is not necessary that the roof be tight. In fact, it will do good to have the top wet occasionally, as it will hasten

decomposition and seal over the top. The silo at the station was left open for three weeks after filling. It rained almost every day during that time, and the rain did not seem to do any harm, as it was only about 12 inches down to the good silage, which is rather unusual.

SIZE.

The size will depend upon the number of animals to be fed, and the length of the feeding period. In Florida it is necessary to feed off at least 2 or 3 inches each day. If exposed to the air for 24 hours it will mould and the stock will not eat it, hence the silo should be built as tall as possible (say 25 or 30 feet), and increase the size to suit the herd. It is estimated that a thousand-pound cow will consume about 40 pounds per day, about 1 cubic foot. If 20 cows are to be fed 6 months, they will require 144,000 pounds, or 72 tons.

Allow a margin of 10 or 15 per cent, as it is almost impossible to fill the silo full, as it settles rapidly, and there is always some loss on top and around the edges near the top.

The following table shows the capacity of round silos:

Depth Feet.	Inside Diameter in Feet.										
	12	15	16	17	18	19	20	21	22	23	24
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
20	45	70	80	90	101	113	125	138	151	167	180
21	47	74	84	95	106	118	132	145	159	173	190
22	49	77	88	99	111	124	138	152	166	182	198
23	52	81	92	104	117	130	144	159	174	190	207
24	54	84	96	108	122	135	150	166	179	199	216
25	56	88	100	113	127	141	157	173	189	207	225
26	59	92	104	118	132	147	163	180	197	215	235
27	61	95	108	122	137	153	169	187	205	224	244
28	63	98	112	126	142	158	175	193	212	232	252
29	65	101	116	131	147	164	182	200	220	240	262
30	67	105	120	136	152	170	188	207	227	249	271

FILLING.

The size of the cutter will usually depend upon the amount of work to be done. Don't get a cutter too small. Less trouble will be had with one that is too large than with one that is too small.

The carrier should not be over 30 feet long, as a long carrier gives a great deal of trouble. The silage should be delivered as near the center of the silo as possible, and moved toward the wall with a pitchfork. Keep it higher next to the wall than the center. One man should be kept busy tramping the silage next to the wall all the time it is being put in; the middle will take care of itself.

Fill just as fast as possible, but no harm will be done if a stop of a day or two is made. After the silo has been filled it will settle, and may be refilled.

Any green material may be used for filling the last foot, as it will rot and be thrown away. Weeds or grass, or, in fact, anything may be used that will decay and prevent the air from getting down to the good silage. If you have nothing else, pull the ears from the corn and use the stalks. The ears may be fed to hogs or other stock. Tramp well, and wet thoroughly. Do not disturb the top until you are ready to open the silo. Any one walking over the surface after it has commenced to rot will do much harm.

If the material being put into the silo becomes too dry, on account of hot winds or any other cause, water may be put on the silage as it goes up the carrier, at the rate of one-half barrel to the wagon load. If water can be pressed out with the hand, there is too much water being used.

The following is the composition of silage from various crops:

Name of Feed.	Dry Matter in 100 Pounds.	Digested Nutrients in 100 Pounds.		
		Protein.	Carbohydrates.	Ether Extract.
<i>Silage—</i>				
Corn.....	20.9	0.9	11.3	0.7
Clover.....	28.0	2.0	13.5	0.1
Sorghum.....	23.9	0.6	14.9	0.2
Alfalfa.....	27.5	3.0	8.5	1.9
Cow Peavine.....	20.7	1.5	8.6	0.9
Soja Bean.....	25.8	2.7	8.7	1.3

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APRIL, 1905.

· FLORIDA ·
AGRICULTURAL EXPERIMENT STATION.
Insects of the Pecan.



Nests of Pecan Case Bearer, *Acrobasis nebulella*.

BY H. A. GOSSARD
(Formerly Entomologist of the Florida Station; now with the Ohio Experiment Station.)

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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PLATE I.

Defoliated by Bud-worm and Case-bearer.
(Two or three weeks after vernalion.)

THE PECAN BUD-MOTH.

(*Proteopteryx deludana* Clemens.)

No other insect except the pecan case-worm, *Acrobasis nebulella*, has done so much damage to pecans in Florida for the past two or three years as has this bud-worm. More often than not it is found working in conjunction with the *Acrobasis*, and when this is the case, only careful observation will distinguish between the two species which have some habits in common, such as entering the buds; also at first sight their respective methods of fastening and webbing leaves together are not greatly different. This bud-worm is a very close relative of the northern bud-worm, *Tmetocera ocellana*, injurious to apple and other fruit trees. Both belong in the same family and so similar are their life histories that if the names of their food-plants were interchanged and the dates for their appearing were slightly altered, an account of the one would read very much like that of the other. In some orchards the depredations of this insect, combined with the damage inflicted by the case-worm, cuts off one-half the yield of nuts.

DESCRIPTION.

MOOTH.—The wing-expanse of the adult is about five-eighths of an inch; length from front to tip of folded wings about five-sixteenths of an inch; length of body about one-fourth inch. The front wings are grayish in color, marked with blackish-brown patches and streaks; in well marked specimens a chain of three such patches makes a zigzag from the base of the wing across its middle to the tip. Along the middle of the hind margin is a rather indistinct patch of gray, becoming distinct when the wings are closed because of the formation of a whitish angle b, the junction of the two patches, one from either wing, the point of the angle being directed toward the head. The grayish front margin of the wing is marked by a series of blackish-brown streaks and splashes from the base to the tip. Iridescent patches are shown here and there, especially in the area along the outer margin between the tip and the anal angle. When the wings are closed the posterior ends are so folded that the general outline of the body is that of an overturned boat; looking at the posterior

end a double, imperfectly formed cylinder is seen at the dorsal margin, somewhat resembling the muzzle of a double-barrelled gun. In the depression just beneath this cylinder on either side, the outer surface of the wing shows one of the conspicuous blackish-brown markings of the zigzag. Hind wings dusky-gray, darker along the outer margin. Head and palpi gray, sprinkled with dark-brown.

PUPA.—The pupa is light-brown in color, slightly over one-fourth inch in length and is cased in a tube of dead leaves, lined with silk. The upper surface of each abdominal segment is armed with two rows of minute teeth, directed backward.

LARVA.—The caterpillar, when full grown and expanded as in crawling, is slightly more than one-half of an inch in length. There are five pairs of prolegs. The true legs, and prolegs also, are light yellowish-green like the body. The contents of the intestinal canal show blackish-brown or reddish-brown through the body. The head is light brown with the anterior border of the mouth parts tipped with black. Thoracic shield is light brown with posterior border and lateral edges tinged with blackish.

EGGS.—The eggs are minute, flattened, semi-transparent, iridescent specks, less than a millimeter in diameter, found on the under sides of the leaflets. Perhaps no better comparison can be made than to adopt the one bestowed on the eggs of the apple bud-moth and liken them to minute fish scales or very small drops of water.

LIFE HISTORY.

The moth has been obtained as early as the 21st of April, but the greater part of the brood does not appear until after the first week in May. They are abundant by May 20th and a few lingerers may be found as late as the 10th of June. As a whole, the brood comes about a week or ten days earlier than the pecan case-worm moth, but for two or three weeks of each spring the moths of the two species may be found together in the same orchards. The bud-moth is most frequently found on the tree trunk where its coloration so effectually hides it that it often escapes discovery, even when the practiced observer is looking straight at it and is but a few feet, or even but a few inches, away.

UOM



PLATE II.

Summer Work of Pecan Bud-Moth (*Proteopteryx deludana*) on leaves.

It invariably settles to rest with its head downward, and when disturbed goes off with a flight so rapid the eye can hardly follow it. After a short circuit it usually returns and alights on the trunk it has just left. Occasionally moths may be started from fence posts or from weeds near pecan trees. I have also found them resting on the trunks of isolated walnut trees and presume they were bred on these. They fly little in the daytime, apparently laying their eggs at night. The eggs are laid on the under sides of the leaflets, and upon hatching the young caterpillars at once commence feeding on the outer skin of the leaflets and, so far as observed, always on the under side. In a very short time each little caterpillar makes for itself a tiny blackish-brown tube of silk, the particles of excrement being used for filling. This little tube is always started alongside the midrib or one of the larger veins, often in the angle made by a vein with the midrib. As growth proceeds, the caterpillar as gradually enlarges its tube, giving it a winding, tortuous course over the leaf-surface away from the midrib or vein that furnished the starting point. These tubes are fastened to the leaves throughout their entire lengths and remain upon them until they fall in autumn. At the larger end of the tube which is kept open, a broadened net-work of silken threads, excrementitious matter and pubescence from the leaf is spread out, tent-like, to protect the body of the caterpillar while it is feeding. The larva only eats through to the upper epidermis which is left intact, causing a brownish patch to appear as the damaged tissues wither, the thin epidermis becoming white and paper-like in autumn or, perhaps, broken through in places from the effects of weathering. The beginnings of these tubes may be found in June, but they do not become conspicuous until July and August. In September the little caterpillars begin to leave their tubes and migrate to the buds where they spend the winter. Part of them will remain upon the leaves until early November, but the great majority of them have gone into winter quarters long before this. At the side of the bud, preferably where the bud scale furnishes shelter on one side and the twig on the other, the caterpillar spins a small, tough, oval, brown "cocoon," lined with white silk, and in this ensconces itself for the winter. Where the caterpillars have been numerous, as many as a dozen of these tiny hibernating "cocoon," scarcely larger

than pin-heads, may be found snugly pressed against a single bud. When the buds begin to swell in spring, the hungry caterpillars come out to feed. Sometimes one eats directly through its winter case into the bud, never exposing itself for a moment to danger from parasites or poisonous sprays; but usually they come from their cases at some other point and feed on the outer leaves of the bud before disappearing in its interior. They commence to issue from their retreats by the middle of March, most of them coming out during the last half of this month and the first week in April. The date of emergence doubtless varies with the season, but may be depended upon to agree quite closely with the opening of the buds. Early damage to pecan buds is due more to this species than to any other, but within a week or two after commencing work it is joined by the pecan case-worm which has just about the same natural capacity for inflicting damage. Both species together, or either one alone, is capable of preventing a tree from getting into foliage for several weeks after its normal time. After the trees are in full leaf the caterpillars may be found singly, each with one side of a leaf folded over it and fastened to form a tube, or sometimes two leaves are fastened together with silken bonds and the caterpillar feeds between them. As fast as the leaves it has attacked become brown and die, it draws fresh leaves to the dead ones and fastens them there, thus gradually making a very conspicuous nest. Whether or not the petioles of these leaves are eaten, thus causing premature wilting, I have not determined, but presume this to be the case. Somewhere in this nest of leaves a silken-lined cocoon is prepared, within which the larva transforms to the brown chrysalis or pupa. The duration of the pupal period is from ten to fifteen days. When ready to emerge the insect usually drags its chrysalis shell with it for a little way, and after freeing itself the moth leaves the empty chrysalis with the head end slightly protruding from the cocoon.

Dyar says the moth is distributed over the South Atlantic States where it is not uncommon.

NATURAL ENEMIES.—Many specimens of *Spilochalcis vittata* have been reared from the insect's nests. Several other unidentified parasites were obtained.

10/11/11



PLATE IV. — "GETTING THEIR PICTURES TAKEN."
Trees show right stage of vernalion for spraying with areolicals in spring.

REMEDIES.

ARSENICALS.—The first experiments tried for the control of this pest were similar to the measures usually employed to subdue the northern bud-worm. In the spring of 1902 an extensive orchard was treated with a Paris green spray, an attempt being made to make the application just when the buds were opening so as to get the worms when they took their first meal in spring. Practically, the method was fraught with many difficulties. In the first place the trees were very irregular in leafing out, adjacent trees often being a week or more apart in their vernalization. It was, therefore, impossible to treat all the trees at the most favorable stage of development without going over the orchard more than once. Again the spring rains coming on at just this season made it very difficult to get the work done at all, and, when done, the rain was apt to undo it before twenty-four hours had passed. Nevertheless, in one instance where rain fell during the night, perhaps twelve hours or less after spraying ceased, an examination of results was made a few days later and it appeared that about fifty per cent. of the worms had been killed; however, the remaining worms were sufficiently numerous to work great damage, and the observer would never have suspected, a few weeks later, that a big fraction of them had been killed. While the orchard seemed to have been considerably benefitted and was injured considerably less than during the preceding year, when no spraying was done, the results were far from satisfactory.

In 1903 Bowker's Disparene and Swift's Arsenate of Lead were tried under very similar conditions in a different orchard. Again the results left much to be desired. The same remedies were used on the bottom parts of a half dozen trees on the station grounds at the time when the buds were partially opened; a few weeks later the contrast between the foliage near the bottoms and at the tops of some of the trees suggested that considerable good had been done, but similar contrasts are sometimes seen on trees that have not been sprayed at all. For spring work it is evident that two or three applications of poison should be made at intervals of not more than a week apart.

In order to avoid troubles incident to the rainy season of spring, irregular vernalization, etc., a different plan was adopted for

1904. Experiments with both spraying and dusting were planned for the months of July, August and September. The young larvæ are feeding upon the leaves during all of this period and it is always possible to find a favorable time for application during these months. It seemed that if a persistent spray, such as Disparene, were thoroughly applied so as to cover the bottom sides of the leaves, the young worms would surely be destroyed before fall. Two or three applications might be necessary, but the plan looked feasible. Upon my removal to Ohio this work was turned over to Dr. Sellards, the new entomologist of the Florida station, but he arrived at his post too late to carry out the experiments planned.

LIME-SALT-SULPHUR WASH.—From the results obtained by the use of this mixture against the northern bud-worm, the cigar case-maker, the apple bucculatrix and all similar pests that enclose themselves in silken cases or cocoons for the winter, it seems probable that this will eventually prove to be the remedy best suited to the exigencies of combat with this insect and the other case-bearing insects herein described. This wash should not be applied until the trees are thoroughly dormant in midwinter, which usually means about the middle of December. Spraying may be done any time between this date and the time when the leaves come out. The peach-worm or peach-twigg borer, *Anarsia lineatella*, is controlled in California by a lime-salt-sulphur spray used just about the time the buds commence to swell, though the same application is effective in midwinter. The larvæ migrate from their silken winter retreats to the buds at this time, which is likewise true of our pecan insect. The soluble elements of this wash are very caustic for the first few days after its application, and it is probable that such worms as are not killed in their cocoons will be destroyed very soon after they emerge. The spring rains might help rather than interfere with the action of this wash. If midwinter work turns out unsatisfactorily, spring spraying should be tried. This wash is an excellent fungicide and, besides destroying so many injurious insects, may be expected to remedy the blights and leaf diseases in marked degree.

FUMIGATION.—One of the chief obstacles to the successful budding and grafting of pecans is this bud-worm. I have seen sticks carrying more than a dozen buds, among which not one

was clean, and most of them had from a half-dozen to a dozen or more winter cocoons attached to them. It is readily seen that the chances for a bud to survive the attacks of all these worms is not great. In a fumigating experiment, a large number of such infested buds were put into the fumigating box and fumigated for 30 minutes, using 0.16 grains of cyanide of potassium per cubic foot of space enclosed. After this treatment, March 26th, these buds were carefully budded into proper stocks by Professor H. H. Hume. Over 90 per cent. of them started into growth in the most promising manner; but in a few days the worms attacked them and out of 27 buds examined, 16, or 60 per cent., had worms visibly at work. The final showing was much worse than this, because all the worms had not issued at the date of examination. Not over 15 or 20 per cent. of the buds survived to produce trees. This strength of gas is wholly ineffective against this stage of the insect. I have further noticed that the little case-worms commonly found on orange trunks are not affected by the California doses of gas, used under oiled tents for an hour. Whether or not a dose sufficiently strong to kill the protected worms can be found that will not injure the vitality of the buds is a question for solution.

NURSERY PRACTICE.—When buds have been received that are infested and must be used it may be doubted if there is any more certain or economical method of handling them than to remove the cocoons with the point of a knife. Possibly the bud-sticks can be immersed in lime-salt-sulphur wash before the buds are removed, but it is an unanswered question as to how such treatment will affect the life and growing power of the buds. The buds from young trees are always less infested than those from old trees and from the entomological standpoint are, therefore, to be preferred. The worms are not often found working on trees of one season's growth in the nursery row. They become more frequent on two-year-old trees and increasingly common as the trees are older and larger.

I believe it is entirely practicable for a man to pass down the nursery rows during July, August and the first half of September, and collect by hand into a basket every leaflet that has a worm feeding on it. Illustrations of such attacked leaflets have already been shown. These leaflets should be burned.

This method will insure clean stock, since no worms will go to the buds if they are destroyed before they quit the leaves. All trees used for budwood and grafts may be treated in similar manner, thus insuring the character of the buds and grafts taken from them.

THE PECAN CASE-BEARER.

(*Acrobasis nebullela* Riley.)

This case-worm is a very close relative of the rascal leaf crumpler, *Mineola indigenella*, which it very much resembles in appearance, life history and habits. Dr. Riley in his fourth report on the insects of Missouri described it as a variety of *indigenella*. No other insect in Florida is more destructive to the pecan and only the bud-worm, *Proteopteryx deludana*, rivals it as an economic insect in the pecan orchard. It seems to be found wherever pecans are grown throughout the State and is probably found wherever the pecan grows wild. It was first described by Riley from a specimen bred from wild crab.

DESCRIPTION.

LARVA.—When expanded the full grown larva is five-eighths of an inch long, color dark green, head dark brown or blackish, prothoracic shield lighter with brownish green area above. Second thoracic segment has a well defined tubercle on the upper surface of each side, skin of thorax doubled into four crescentic folds directed alternately forward and backward, a pair each to the second and third segments. Legs shining blackish. Four pairs of abdominal prolegs short, hardly more than tubercles. Fifth or last pair of prolegs longer, armed along the border with numerous minute hooks by means of which the caterpillar clings to the silken lining of its case, rendering difficult the attempt to draw it therefrom, such effort sometimes threatening to tear the body in twain.

PUPA.—The pupa is three-eighths of an inch or less in length, color glistening mahogany brown; dorsal surface minutely punctate.

MOTH.—The adult moth has a wing-expanse of .6 to .75 of an inch, length of body .3 to .375 of an inch. General color of insect gray, marked with whitish, cinnamon-brown and black.

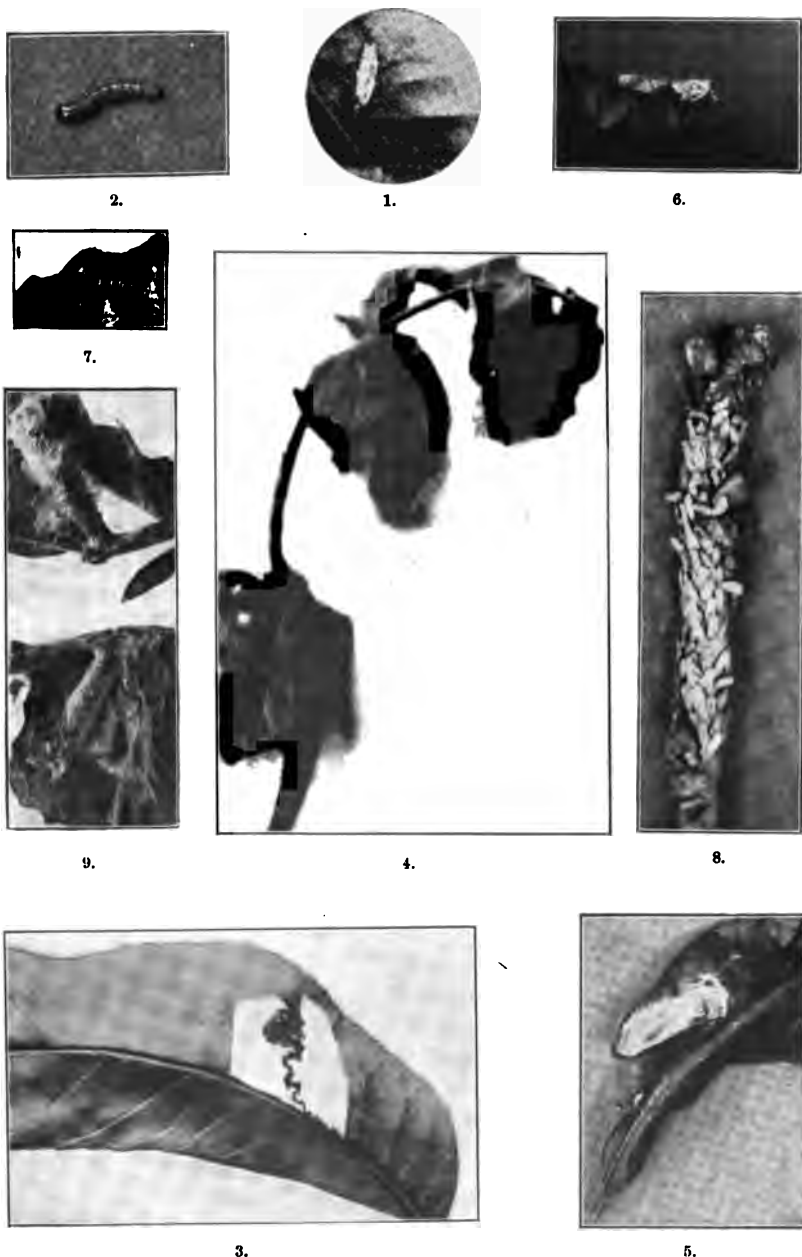


PLATE III.—BUD-WORM AND CASE-BEARER.

Proteopteryx deludana: 1, Moth, slightly enlarged, on surface of a leaf; 2, Caterpillar, natural size, about mature; 3, Part of leaf cut away to show tortuous tube of young larva; 4, Nests of dead leaves in which mature larvæ and pupæ are found; 5, Folded leaf, rolled back to show chrysalis in silky cocoon. *Acrobasis nebulella*: 6, Moth, natural size, resting on leaf; 7, Caterpillar, natural size, about mature; 8, Winter cases, perhaps of this species but very probably of *Coleophora*, clustered on twig, slightly enlarged; 9, Cases of grown worms, attached to leaves and twigs, enlarged.

A row of seven or eight crescentic or linear black spots is found near the outer margin of the fore-wing. About one-fourth the length of the wing inward from the margin is a gray wavy line, rendered clear by a dusky background on either side of it. Slightly nearer the base than the outer termination of the costal margin is a triangular dusky spot, and just outside it toward the margin are two small black spots, the one behind the other. Not far from the base is a splotch of light cinnamon-brown inclining to yellow and at the base is a whitish or, in some specimens, grayish area, which again in other individuals merges into dark color. The hind wings are light at the base, becoming dusky gray toward the outer margin, a slender double line of black appearing at the fringe. Head, shoulders, thorax and sometimes upper parts of legs silky white, or in other specimens the color passes from white through all gradations to dusky gray. Tibiæ and tarsi variable, but some of them always spotted or ringed with white and black.

LIFE HISTORY AND HABITS.

There is but one brood per year, the moths appearing from the first of May until the first of July, the bulk of them coming as a general rule during the first half of June. The moths are found in the mulch and trash at the bases of trees, on low weeds in the orchard, and upon the leaves and branches where they can hide in the thick foliage. When pursued in the mulch they deftly slip downward among the straws, and owing to their quickness and protective coloration generally elude even a very skillful chase. When alarmed into taking wing, they make a short and somewhat jerky flight to a tree trunk or to nearby foliage or weeds. The position or angle of rest is apparently determined altogether by the position in which the insect happens to alight. This habit readily distinguishes it from the bud-moth, often associated with it in the pecan orchard, by the latter's habit of invariably adjusting itself, head downward, on the bark.

Its summer history agrees well with that of its twin relative, the leaf crumpler of the apple and other orchard trees, *Mineola indigenella*, the eggs soon hatching, after which the young caterpillars commence feeding on the younger leaves, especially those

just opened at the terminal ends of branches. In July they are readily discovered concealed in these terminal tufts, the blackened, ragged border of eaten spots among the cluster of leaves betraying their presence very quickly after they commence feeding. Before long, each constructs a tube about its body, weaving into it the particles of its brownish or blackish excrement, bits of disintegrated bark, and such debris with silken threads of its own manufacture. The case which is considerably longer than the body of the caterpillar is well lined with white silk. While the case is in the formative period it is of comparatively flimsy texture and more or less curved, but, if the usual order of development is followed, long before the worm matures the case becomes quite straight, the distal or unattached end always being larger than the attached one. The larval habit and the case formation seems to be intermediate between that of *Mineola indigenella* and the walnut case-bearer, *Mineola juglandis*. Through this open, larger end, the worm protrudes itself to feed, most of its depredations, at least with specimens more than half matured, being done at night. When mature in May, the case is so tough and dense that it tears with the greatest difficulty and at this time is usually of a grayish-slate color. Before the leaves fall in autumn the insect probably attaches its case to a suitable spot on a branch and here the winter is passed. They do not come forth in the spring quite so early as the bud-worm, but sometime during the last week in March or the first half of April they appear on the leaves with seeming suddenness, their cases at the dates when I have observed them being from one-half to three-fourths of an inch long. If they are numerous, the trees will have a struggle to put forth leaves as fast as they are devoured. They often enter the buds and, in case of terminals, cut off growth, compelling the development of lateral branches as occurs following damage by the twig-girdler. Sometimes the caterpillar bores for a considerable distance into tender twigs. Bloom buds are destroyed along with leaf buds. Numbers of the caterpillars sometimes enter an opening leaf cluster and tie together into a coherent mass as large as a goose egg such leaves as are opened, and add to them others as fast as they appear, or as much of them as is undevoured. Through the mass are scattered the cases containing larvæ and pupæ,

perhaps as many as a dozen moths eventually hatching from the mass. I have seen trees kept defoliated and struggling for six weeks or more to leaf out in the spring, the trouble at times being almost wholly due to this species, again being caused by it and the bud-worm, working conjointly. Later in the spring a very characteristic habit is for the insect to attach its case to the main leaf stalk, then tie over it, from each side, the opposite leaflets of a pair, the tip ends of the leaflets, or of one of them, being first eaten, consumption proceeding toward the base; thus protection and food are provided for at the same time. Sometimes two or three cases are sheltered in this manner by the same pair of leaflets.

NATURAL ENEMIES.—From the larvæ and pupæ have emerged in my breeding cages a Tachinid fly, two or three ichneumon flies and a very minute hymenopteran which, from recollection, I think to have been a braconid. Part of these parasites were lost in the confusion of moving to another State and I can only be sure of the identity of *Pimpla conquisitor* and *Spilochalcis vittata* among them. The cumulative benefits of parasitic attack were illustrated by a few trees on the station grounds, which during April and May, three years ago, were well-nigh unable to get into foliage; for the past two years they have been in much better condition, due almost wholly to parasites. Some correspondents report having observed birds pecking them from out the buds and eating them.

REMEDIES.—It seems certain that whatever remedies are found efficient against the preceding species will also control this one. The life histories of the two pests run so nearly parallel that the only marked difference in their time schedules is a little earlier appearance of the bud-worm moths than of those of the case-worm. This variation is scarcely more than a fortnight or ten days. The larvæ of both species are feeding from June until September or October and can possibly be reached by arsenical poisons during this period. Arsenate of lead promises best results among the arsenicals. From midwinter until the leaves begin to open both species are quiescent and probably vulnerable to the lime-salt-sulphur wash. In March and April the larvæ again become active and are to some extent amenable to treatment with poisons just when the buds are opening. Two

or three spring treatments are advised where winter treatment has been omitted.

OTHER BUD-WORMS.

In his report on injurious insects for the year 1902, made in the Yearbook of the U. S. Department of Agriculture for 1902, Mr. Chittenden mentions three species of moths belonging in the same family with the pecan case-worm, viz: *Acrobasis rubrifasciella*, Pack., *Acrobasis angusella*, Grt., and *Acrobasis palliolella*, Rag., doing injury to pecan buds in different localities in Georgia. Not enough is known of these bud-worms to warrant more than a surmise that the remedies which have already been recommended for species of similar habits will prove effective against these.

CATOCALA SPP.

(*Catocala piatrix* Grote and others.)

It is probable that several species of *Catocala* feed on the pecan. I have observed at least two species, and many of those recorded for the hickory and walnut probably feed on pecan also. The general body color is grayish and so closely mimics the color of the bark that the caterpillars may escape observation, even when one is looking straight at them from a very short distance. They hide by day in crevices in the bark, lying very flat and close to the trunk. This habit, joined to their great size and leathery-looking skin, has suggested to some of our orchardists the name of "alligator worms" for them. The only species I have reared, and one of the commonest of these "alligators" is *Catocala piatrix*, of which the following is a description:

LARVA.—Length when full grown and extended on the bark, over three inches. Middle of body swollen, tapering smoothly toward each end. When younger, the gray ground color is tinged with bluish. In mature specimens, a black stripe extends along the middle of the back, its continuity being more or less broken by narrowing at the joints. On each side of this dorsal stripe is a broader stripe surrounding within its darkest expanded areas small grayish spots; agreeing pretty well with the course of each of these lateral stripes is a row of light pi-

liferous spots. Top of head blackish, front lighter, its sides striped with light and dark brown. Ventral surface flesh-colored with a black spot to each segment. There is a blackish stigmatic line on each side. The two interior pairs of abdominal legs are only from one-third to one-half the size of the two posterior pairs. When at rest the insect lies very close to the bark. Besides pecan, feeds on walnut, hickory and persimmon.

PUPA AND COCOON.—The cocoon is made by fastening several leaves to the outside of a rather thin, silken oval or egg-shaped case, within which the dark brown pupa, powdered with a white bloom, lies for about three weeks, at the close of which period the moth appears.

MOOTH.—The moth has fore-wings of a dark, wood-brown or blackish-brown color, slightly silky. Near the base of each wing is a black tranverse line and outside of this, at a distance of about one-fourth or one-third the length of the wing, is another tranverse, wavy black line. The space between these two lines is shaded into dusky. About the middle of the front border is another dusky patch extending back to the center and near the outer border, back a little from the apical angle, is a third small dusky splotch. Located within the second dusky area is a dark, kidney-shaped spot, and immediately behind this a pale spot of quite similar shape. Just outside the dusky spot is another angled tranverse line, forming a heavy, black M. Along the outer border is a scalloped double line of black with light brown or gray between. The hind wings are deep yellow with two transverse black bands, the outer one nearly twice as broad as the inner one; bases and inner margins dusky; a yellowish fringe extends along the outer border. The body length is about one and one-fourth inches, wing-expanse about three inches. Distributed over the eastern United States.

Catocala viduata Guenee (?).

Another catocala caterpillar found about as abundantly as *C. piatrix* in Florida pecan orchards is probably *C. viduata* Guenee which has been reared by Mr. Herrick. I did not rear the adult moth, but from my notes furnish this description, which seems to agree pretty well with that of Mr. Herrick:

LARVA.—Length when grown about two and one-fourth inches, the body not so tapering as that of *C. piatrix*. Head

striped with gray and brown, a black spot at base of each antenna. A brown stripe extends along the back or dorsum, expansions of the same occurring at the anterior and posterior end of each segment, the expanded portion surrounding a small darker spot. A darker stripe, splotted with black, borders the dorsal brown stripe on each side. The under surface is of a deep flesh color, a deeper reddish spot being located on each segment; the two segments preceding those which bear the prolegs, and the anterior two segments bearing prolegs, have each a black spot in the center of the deeper red, the two posterior ones being much larger than the anterior two. First two pairs of prolegs smaller than the others, but difference not so great as in *C. piatrix*. Hide has a tough, leathery appearance, making the appellation "alligator worm" quite appropriate.

PUPA.—The pupa and cocoon are very similar to those of the former species.

Mr. Herrick gives the following description of the moth of *C. viduata*:

MOTH.—"The adult insect is a rather large moth of sober but soft and velvety hues. The body is usually stout and about one-inch long and is light gray in color. The wings have an expanse of two and three-quarter inches and in some specimens of three inches, or even a trifle more. The hind wings are dark-brown above, growing lighter towards the body, and edged with a narrow band of white. The front wings are gray above, with a dark stripe, describing an imperfect arc of a circle across the front and outer corners. These wings are crossed transversely with light and dark wavy lines. When the wings are folded and the hind ones are covered by the fore-wings, the moth shows a remarkable resemblance to the bark of hickory and pecan trees. On the under side the front wings are crossed by three dark, wide, wavy lines, while the hind wings are crossed by two only. Distributed over the South Atlantic States."

REMEDIES.—These larvæ are most in evidence in April and early May, most of them having disappeared before the first of June. They may be poisoned by arsenical sprays thoroughly applied in April, or they may be gathered by hand from the trunks of the trees during or just after a rain. The rain darkens the bark and the lighter bodies of the caterpillars become con-

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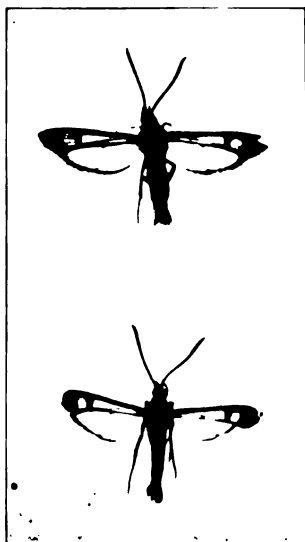
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PLATE V. — THE PENITENT CATOCALA AND THE PECAN-TREE BORER.

Catocala piatrix: 1. Adult moth, reduced one-third; 2. Caterpillar against oak bark, slightly injured; 3. Leaves, enclosing cocoon of same. *Sesia scitula* (after Herrick): 4. Female Moth above, male moth below, enlarged; 5. Two newly set buds destroyed by larvae of the borer.

spicuous against the dark background. The worms feed at night and will collect under bands of burlap tied around the trees so as to produce some loose folds beneath which they can readily hide. They should be collected the following morning and destroyed by crushing or they can be dropped into a vessel containing kerosene. An astonishing number will sometimes collect under a single band in one night.

THE PECAN-TREE BORER.

(*Sesia scitula* Harris.)

This insect, named by Professor Herrick, of the Mississippi Agricultural Experiment Station, the Pecan-tree Borer, has not often been reported in Florida. In one instance damage to newly inserted buds was described to me in such a manner that there can be little doubt that the injury was caused by this insect.

The adult is a clear or transparent-winged moth, somewhat wasp-like in appearance, similar to the moth of the peach-tree borer. The wing-expanse is from three-fourths to four-fifths of an inch and the body length about three-eighths of an inch. The general body color is bluish black, conspicuously marked with yellow. On each side of the thorax, between the wings, is a yellow line, and there is a narrow yellow ring on each of the second and the fourth segments, the latter having its entire under side yellowed. The tuft at the end of the abdomen is black, in the female being edged on each side with yellow. The legs are marked with yellow, also the wings have some yellow markings on the outer margin, most noticeable in the female. The hind wings are transparent with blue-black markings.

HABITS.—The young borer is apt to gain entrance to the sapwood through some wound in the bark, such as a graft-union, and here it feeds, sometimes completely girdling the sapwood above and below the wound. It is said to prefer to attack buds that have been budded on old, large trees. As a general rule the burrows ascend the tree in a spiral about the trunk, so complete girdling is unusual, but growth sometimes ceases above the groove, new limbs being shot out from below. When girdling is more or less complete, bridge grafting may be of service. The eggs are laid early in the year, probably during April and early

May. Whether there is more than one brood is unknown. Larvæ may be found in the burrows in winter and pupæ are developed the following spring. The cocoons, made of excrement and bits of bark fastened together with silk, are spun in the burrows. The moths may be found on the wing during April. This insect is found in Canada and probably in all of the American States east of the Mississippi river. Besides pecans it is recorded to feed on oak, chestnut, dogwood and probably on hickory and willow.

REMEDIES.—The only certain and reliable remedy is to keep a close watch on trees that have been newly budded or wounded in any way, dig the borers out and kill them. Possibly a liberal application of grafting wax with which white arsenic or Paris green has been mixed will afford some protection. Over the grafting wax a repellant, such as carbolized fish-oil soap may be spread. Such a repellant may be prepared as follows: With eight gallons of water dilute one gallon of whale-oil soap to which one pint of crude carbolic acid has been added. The addition of two or three pounds of lime to this mixture will increase its permanency.

Any barking of the trees or wounds inflicted in course of cultivation may be closed with poisoned wax bound to the wound with rags or preferably with wax cloth, such as grafters use; or fresh cow dung may be poisoned with arsenic or mixed with tobacco dust and bound on in similar fashion. This insect must not be confused with the bud-worms previously described which attack the leaflets before the buds have opened.

THE WALNUT OR PECAN CATERPILLAR.

(*Datana interrigma* Grote and Robinson.)

Sometimes in midsummer and again in the fall of the year large bunches of caterpillars from one and one-half inches to two inches long collect in a writhing mass on the trunks of pecan trees and after moulting their skins, which are left adhering to the trunk, reascend the tree and again begin feeding.

The caterpillars are the larvæ of a buff-colored moth having four tranverse brown stripes on the fore-wings; the head is light brown, the prothorax darker brown; the body length is a



PLATE VI.—WORK OF WALNUT CATERPILLAR AND FALL WEB-WORM.

Tree defoliated in autumn by colony of *Dalana interrigma*. The conspicuous nests are the abandoned webs left by an earlier colony of *Hyphantria cunea*.

little over one-half inch, the wing expanse from tip to tip of the outspread wings one inch and three-quarters. The eggs are laid in clusters of several hundred on the under surface of the leaves, usually those of the lower branches. These eggs vary in color with age from light greenish to glistening marble-white. The eggs hatch within a week and the gregarious habit of the caterpillars is exhibited from the first. Upon hatching the general body color is light with reddish markings on the back. At a later stage more red appears and when the worms attain the length of an inch four light longitudinal stripes appear on each lateral half of the body, the first and third, counting from the middle line of the back, being but faintly indicated. After passing the fourth moult the general color is blackish with two white lines running along either side of the body, the broadest one below the spiracles, and the body is covered with dirty white hair.

In common with other species belonging in the genus *Datana*, the caterpillars are not easily shaken from their feeding places and when alarmed will raise both ends of their bodies from their supports, maintaining their hold exclusively by means of the middle prolegs. When about to moult for the last time they descend to the trunk of the tree and collect in a single mass as previously mentioned. The cast skins of the mass, webbed together, may remain clinging to the bark for several weeks or even months after the moulting occurs. Within a few hours after moulting they reascend the tree and feed for a short time, then descend to the ground and burrow a few inches beneath the surface where they construct earthen cocoons in which the pupal stage is passed. Two broods per year have been observed in Florida and more careful attention to the insect would possibly have discovered three. I have observed the caterpillars of the first brood feeding as early as May 14th, and these must have hatched a few days earlier. The adult is a buff-colored moth with four tranverse brown stripes crossing the fore-wings. It has a wing-expanse of about one and three-fourth inches.

NATURAL ENEMIES.—The eggs are attacked by a hymenopterous parasite and the caterpillars by *Tachina* flies and doubtless also by various hymenoptera. Some birds are fond of the caterpillars, the yellow-billed cuckoo or rain crow, *Coccyzus*

americana, being reported as a specially valuable consumer of them.

REMEDIES.—The eggs may be found on the leaves among the lower branches and destroyed before they hatch. Careful observation will usually discover the young colony while it is yet confined to a few leaves and the whole can be gathered and destroyed with ease. At a later time a careful lookout will enable the grower to kill the colony when it is massed on the trunk to moult. Here they may be destroyed by crushing or by a kerosene spray. A lighted knot of resinous pine or kerosene torch will be effective against the worms wherever they are massed together, either on the trunk or on the branches. Spraying with the arsenites, such as Paris green or arsenate of lead, will prove efficient.

THE FALL WEB-WORM.

(*Hyphantria cunea* Drury.)

Every pecan grower would doubtless recognize this insect from its name alone, even if no description of it and its work was included. The webs are especially conspicuous in autumn, those of the spring brood attracting less attention.

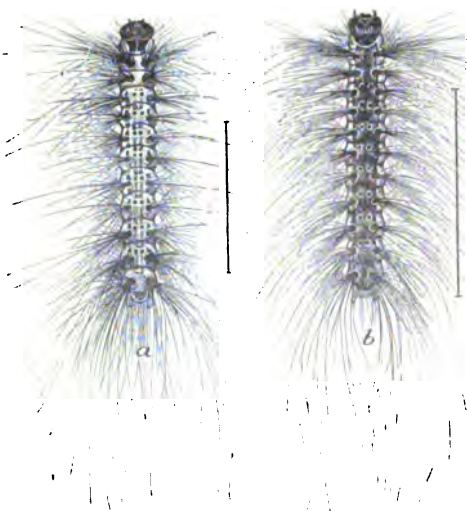
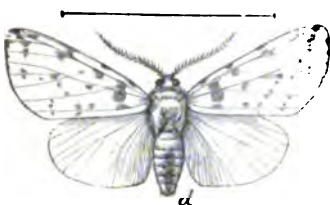
The winter is passed in the pupa state, the moths appearing with the opening of the buds in spring. The eggs are laid in clusters of 400 to 500 on the leaves, probably as early as March in some cases, but chiefly during April. The eggs are of a pale delicate green color, covered with white down from the abdomen of the female. The eggs hatch in a week or ten days into very hairy, large-headed caterpillars which always live in webs that are enlarged as the need for greater pasturage is felt. These webs are noticeable enough in May, loosely enclosing many leaves and twigs. The worms when full grown are about an inch long and are clothed with long white and black hairs projecting from numerous black tubercles. To pupate, the matured caterpillars hide beneath trash on the ground, under the loose bark of trees, in cavities in the tree-trunk, in fence corners, or perhaps most often just beneath the surface of very loose soil. The cocoon is of thin, flimsy, almost transparent texture, composed of a slight web of silk with a few hairs and sand grains intermixed. The pupa is of a very dark brown



1.



2.



4.



5.

PLATE VII.

1. Moth of Walnut Caterpillar, *Datana interrigma*, about natural size (after Herrick); 2. Caterpillar of *Datana interrigma*, showing characteristic attitude when disturbed. 3. Fall Web-worm, *Hyphantria cunea* (from Farmers' bulletin No. 99, U. S. Dept. Agr., Bureau Entomology); a and b, caterpillars of same; c, pupa; d, moth (a, b, c, d, all enlarged); 4. Eulecanium sp. 5. Cottony scale, *Pulvinaria innumerabilis*.

color, a little more than half an inch long, with a slight projecting band or bulge near the middle. The pupa state lasts about a week for the summer brood of moths and several months for the early spring brood.

The moths are sometimes pure milk-white in color, with tawny-yellow and blackish markings on the legs and feet, while others have few or many black and brown spots scattered over the wings. There is so great a range of variation in the markings that the different individuals appear to belong to as many different species, but breeding experiments have proved them to be identical. The females measure from one and one-fourth inches to one and three-eighth inches across the expanded wings, the males a trifle less. The second or summer brood of moths appear in June or July. The webs of the second brood of worms are very noticeable in August, September and October. Most of them will have gone into the ground to hibernate before the close of September, but the unsightly webs persist in the tree tops for many weeks longer. This brood often defoliates large limbs and not infrequently a large part of the tree-top.

NATURAL ENEMIES.—Because of their hairiness, few birds will eat the caterpillars. The cuckoos probably feed on them as they readily eat hairy caterpillars of various kinds. Toads eat them and a few spiders are on record as devourers of them. Among predaceous insects, the wheelbug, *Arilus cristatus*, preys on them, so do some of the Mantidæ or Rear-horses. Several species of Pentatomidæ or "stink bugs" kill them and suck the body juices. A minute hymenopteran parasitizes the eggs, and several species of the same order of insects attack the caterpillars; also, some of the Tachina or flesh flies feed on them.

REMEDIES.—The small webs of the young caterpillars may be removed from young trees and the worms destroyed before much damage is done. On older trees, a fat pine knot, or rag or asbestos torch saturated with kerosene, may be fastened to a long pole, lighted, and used as a torch to burn the web. Any of the arsenical sprays will be effective if freely used. Spray until the leaves are covered with mist, but stop before dripping commences, is the theoretical rule; practically, some dripping is very likely to occur if the work is thoroughly done.

COLEOPHORA SP.

An unidentified species of *Coleophora* is at times a most serious insect, judging from reports of correspondents and the specimens of damage sent in. While it was thus reported but twice during my six years' service as entomologist of the Florida station, it was found in small numbers upon almost every tree I examined for the purpose of finding it. In winter the empty cigar-shaped cases, about one-half inch in length or perhaps a trifle more or less, may be found attached to the bark of the trunk and limbs. The distal or unattached end of the case is always flattened and square when the larva is about matured, as is also the attached end, but possibly in less degree. The cases are generally of a light brown color, though some are darker and suggest the color of a light cigar wrapper. The larvæ carry their cases about with them wherever they go, holding them at an angle approaching 90 degrees to the surface to which they are attached. One side of the leaf epidermis is uneaten and frequently the larva feeds like a miner, thrusting its head through an opening in the epidermis of one side and eating out the pulp between the two epidermal skins for a radius equal to its body's length. These eaten spots become whitish or brownish in color and are somewhat suggestive of a blight or spot disease. The moth is a beautiful little creature, with light brown silky wings, the front margins of the fore-wings each being bordered with a white or silvery line. Both pairs of wings are heavily fringed. The moths issue in late May and early June.

REMEDIES.—The lime-salt-sulphur wash applied in winter after the trees have become entirely dormant, preferably about the time the buds commence to swell, will doubtless destroy many of them. Arsenate of lead or Paris green has proved effective against other species of the same genus when applied during their feeding period and the same poisons will doubtless be effective against this marauder. It may be wise to add an arsenical poison to the lime-salt-sulphur wash if the application is made late, that is, after the insects have commenced activity.

THE HICKORY-SHUCK WORM.

(*Grapholitha caryana* Fitch.)

A small white caterpillar about three-eighths of an inch long, sometimes mines the shucks of the developing nuts, causing them to cease growth and shrivel up, many prematurely falling. I have noticed its work in only two or three Florida orchards. Fitch describes the moth as follows: "Sooty black, the fore-wings with reflections of tawny yellow, blue and purple; their outer edge black, with oblique triangular whitish streaks placed at equal distances apart. A very oblique faint silvery blue streak extends inwards from the points of two of these white streaks, namely, the fourth and sixth ones from the tip of the wing; while the usual white spot on the inner margin of the wings is wanting. Expanse of wing .60 inch."

The moth is supposed to issue in the fall and hibernate over winter, laying its eggs in spring. No remedy can be suggested without fuller knowledge of its life history, except to keep the infested nuts picked up as fast as they fall and burn them.

THE TWIG GIRDLEERS.

(*Oncideres cingulatus* Say.)

(*Oncideres texana* Horn.)

Every pecan grower knows the girdler. In the fall of the year, during September and October, few pecan trees escape having some of their smaller branches girdled, causing them to break off and drop to the ground. The cut is circular and quite smooth, only a few woody fibers remaining uncut to support the twig until the wind snaps it off. This cut is made by a dark-gray, long-horned beetle, between one-half and three-fourths of an inch long, its back or wing-covers sprinkled over with faint tawny-yellow dots. It is covered with short grayish hairs, thickest on the head and thorax, and forming a broad band or lighter colored portion on the front part of the wing covers. The antennæ or horns are about the length of the body in the female, somewhat longer in the male. This description applies to the Florida species, *O. cingulatus*, which has been taken in the act of girdling. I have not encountered the other species, *O. texana*, in Florida, but it is said to be the more destructive of the two in Mississippi. It resembles *O. cingulatus*, but has red

instead of tawny-yellow spots on the wing covers. In the Year-book of the U. S. Department of Agriculture for 1902, Mr. Chittenden reports both species injuring pecan, especially in Alabama and South Carolina.

The beetles work very quietly and are inclined to make no movement when they are discovered, unless an attempt is made to carry them off, when they manifest some interest in effecting an escape. The twigs are girdled for the purpose of assisting the young to develop. Before or immediately after girdling the twig, the female deposits one or several eggs beneath the bark, one under each of several buds as the rule, and the cut is made below these eggs so they will be in the part of the limb that falls. Perhaps the primary purpose in cutting the twig is to kill it, since the larvæ seem best adapted to living in dead but not too much decayed wood. The moisture absorbed from the ground by the fallen limb also is doubtless of distinct value to the growing larva and quiescent pupa. The insect requires one year, perhaps in some cases two, to complete its life-cycle, all the preliminary stages being passed in the fallen twig from which the adult beetle emerges in autumn, usually in September.

REMEDY.—Pick up and burn the fallen limbs in fall and winter. Since the beetle breeds on so many other trees than pecan, such as hickory, walnut, persimmon, etc., this can be only a partial remedy; but where it has been tried on trees partially but not wholly isolated from the native forest, the trees in some instances having become badly stocked with the pest through continuous neglect, the gain in yield of nuts has sometimes proved very surprising.

THE OAK PRUNER.

(*Elaphidion villosus* Fab.)

Sometimes pecan twigs, when smartly bent, will snap off with a clean, square cut across the branches as if they were hollow glass tubes, breaking at cracked or weakened places. An examination of such a broken stem shows that its woody part, with the exception of a few fibers and the bark, has been cut across as if with a saw by a soft yellowish-white grub which can often be found in a burrow in the severed part. Since the uncut bark is the chief support left for the branch, any stiff wind or even its own weight will break it off as soon as it has be-

come deadened. While I have not personally bred the beetle from the larva which commonly affects pecan twigs in this manner in Florida, the larva is apparently the same as the one affecting oak and occasionally orange twigs, and Mr. Herrick, of the Mississippi Experiment Station, has bred the Oak Pruner, *Elaphidion villosum*, from pecan twigs. Besides oak and orange this insect works in hickory, chestnut, apple, plum, peach, grape, wistaria, and a number of other plants.

The adult is a longicorn beetle, of slender, cylindrical form, over one-half inch in length and about one-eighth of an inch in width. It is of a dull black color, tinged with brown on the wing covers, especially toward their tips. The underside of the body and the legs are chestnut colored. Over all parts of the body can be found short grayish hairs. Some small gray spots on the wing covers and a whitish dot on each side of the thorax are formed by dense collections of gray hairs at these points. Coarse round punctures are thickly sprinkled over the upper surface of the thorax and wing covers.

The larva, when grown, is about three-fifths of an inch long, tapering backwards from the neck. The body is divided by deep grooves into twelve rings or segments. There are three pairs of feet. The color is yellowish-white, the front of the head being blackish. Probably about midsummer, with a possible variation of two months in each direction from this date, the parent beetle deposits her eggs, preferably on a small twig of the preceding year's growth. Upon hatching, the young larva commences to eat the tender wood just beneath the bark, and later enters the center of the twig and works toward its base. In this manner it works its way into the main limb which may be of considerable size and feeds within it for a period of about three years. The burrow thus becomes several inches in length in many cases. Just before transforming to pupæ some, but not all of the larvæ, cut the wood for the purpose of dropping the branches as before described. Limbs in which the immature larvæ are working often break off with ragged end when bent with the hand.

REMEDY.—Pick up and burn all fallen branches. Similar attention should be given nearby oak and hickory limbs which have fallen.

THE LIVE-OAK ROOT BORER.

(*Mallodon melanopus* Linn.)

While the insect is very common in Florida, it has never been observed or reported to me as a pecan insect. Mr. Herrick reports it from Mississippi as having been found working at the roots of the pecan. Sooner or later it will doubtless be found inflicting similar damage to the pecan in Florida. Normally, the very large grub of this insect, which becomes over three inches long, works on the roots of the live oak tree. The adult is one of our largest, long-horned beetles, dark brown in color and often over two inches long.

REMEDIES.—Keep a watch on the roots of pecan trees, especially those under six years old, and if the grubs are present destroy them. If not too far in the wood they may be dug out. Flexible wires can sometimes be run into their burrows and they may thus be killed. Again, wads of cotton can be saturated with chloroform or bisulphide of carbon and thrust into the burrows, the openings being at once stopped with clay-mud, putty, or similar substance.

THE HICKORY-NUT WEEVIL.

(*Balaninus caryae* Horn.)

Only occasionally have I found pecan nuts in Florida with holes bored in them, suggesting the work of the hickory-nut weevil; and I have given the insect no attention further than a mere notice. However, since it may become more destructive within the State in future years, it merits a brief treatment.

The adult is a small curculionid or snout beetle, blackish-brown in color, and nearly one-half inch long. It is reported to be a very serious pest of the pecan in Missouri and Texas, destroying a considerable quantity of nuts each year. The female uses her snout, terminating in a pair of biting jaws, to excavate a hole through the tender shuck in the early part of the season, and at the bottom of the hole deposits an egg. The young grub feeds on the kernel until fall, when it bores a round hole out through the shell, then goes into the ground and pupates preparatory to passing the winter.

REMEDIES.—It is said that heating the nuts to a temperature of 125 degrees to 150 degrees Fahrenheit will kill the grubs

and thus stop their work before they have entirely ruined the kernel. Nuts should be gathered early and heated at once to secure satisfactory results. If the nuts are placed in an air-tight chamber and fumigated with bisulphide of carbon, one pound to each 1000 cubic feet of space enclosed, for a period of 48 hours, the grubs will be destroyed. *Keep fire away from carbon disulphide* or an explosion and conflagration will follow. All nuts must be gathered from the ground and subjected to treatment, and should any hickory nuts be in the near neighborhood, they should be treated likewise, if possible.

THE HICKORY-BARK BORER.

(*Scolytus quadrispinosus* Say.)

This insect is recorded as an enemy of pecan in the more northern pecan sections and either it or an insect with very similar habits has been reported to me in Florida. Unfortunately I was unable to procure specimens of the damage to make the identification certain. With so many other insects in Florida that have a far northern range, it seems exceedingly probable that this one is also present.

The beetle attacks the various species of hickory, making long narrow channels beneath the bark which radiate from a larger central vertical chamber from one-half an inch to an inch in length. The vertical chamber is excavated by the female which places her eggs, varying in number from 20 to 40 or 50, on each side of it. The larvæ, when hatched, feed on the inner bark, each one following a separate track which is marked distinctly on the wood. At first these channels run transversely but at a later stage lengthwise along the trunk. The ever-enlarging burrows are always partially filled with sawdust-like excrement which is of the same color as the bark. The soft, yellowish, grub-like larva, when full grown, is slightly less than one-fourth of an inch in length and entirely legless. The head is darker with brownish jaws. The winter is passed in the larval stage, the pupa developing in April or May. Some beetles probably issue in June in Florida, though the bulk of them may be expected during July and August as in the northern States. The eggs are deposited soon after the beetles appear.

The adult beetle is entirely black, or black with brown wing-

covers, and is a little less than one-fifth of an inch in length; the wing covers have about ten striæ, produced by small, deep, contiguous punctures, the spaces between the striæ having a single row of minute, well-nigh imperceptible punctures. The head is more or less hidden by long fox-colored hair, more dense in the male than in the female.

The beetles bore into the trees in May, June and July, the males to procure food and the females for the purpose of oviposition. The burrows run obliquely upward and small branches as well as twigs are attacked. Twigs are commonly entered at the axil of a bud of a leaf, the damage often causing the leaf to drop and the twig to die and break off. The eggs are deposited in July, August and September in northern latitudes, and the same period, with one or two preceding months added, will probably be nearly correct for Florida.

NATURAL ENEMIES.—Two minute hymenopterous parasites are recorded as preying on the larvæ and these probably do much to check over-multiplication. Woodpeckers do good service in finding and consuming them. The yellow-bellied sapsucker, *Sphyrapicus varius*, however, is a woodpecker that pecks holes in trees for the purpose of imbibing sap from them. It should be shot without scruple when observed at work on a pecan or other valuable tree. It often pecks one or several rows of holes entirely round the trunk and does more damage in a day than bark-beetles are apt to do in a year. By weakening the trees it attacks, bark-beetles are invited to follow, for they prefer weakened trees. Generally speaking, the other woodpeckers are good friends and merit encouragement.

REMEDIES.—Since weakened trees are most subject to attack, though perfectly healthy ones are not wholly exempt, the best preventive of damage is to fertilize properly and cultivate well. Such stimulation will often enable a tree already attacked to throw off the insects and recover. If the trunk and limbs are well sprayed with whitewash to which Paris green has been added just before the egg-laying period begins, it will hinder in some degree the deposition of eggs and the entrance of the young larvæ into the tree. Or a heavy spray of carbolized whale-oil or soft soap, prepared as directed in the section on the Painted Hickory Borer, may be used instead, during the same period. Pieces of

soap tied to the main limbs and trunk during the egg-laying period for the rains to dissolve and carry down may at times be helpful. If the beetles are detected at the outset of their attack, a sponge may be saturated with kerosene emulsion or creosote oil and turpentine, then fastened to the end of a pole, and the affected spots can be lightly painted with the preparation. Dr. Hopkins reports good results in saving hickory timber from the ravages of this beetle by girdling a few trees in August. The beetles flocked to these trees to lay their eggs, but the wood was burned for firewood the following winter and the brood destroyed. When a pecan orchard is badly attacked, the unaffected trees can probably be saved by girdling and afterwards destroying a number of the weaker ones. In Florida this girdling would probably be best performed in June or early July.

THE PAINTED HICKORY BORER.

(*Cyllene pictus* Drury.)

This insect, said to bore into pecan trees as well as hickory, doubtless will someday be recorded as attacking the pecan in Florida. Thus far, I have heard nothing to suggest that it has already made such a record.

The adult is a velvety-black, long-horned beetle with a number of pale yellow transverse bands across the wing-covers and thorax. The second band on the wing-covers, back from the yellowish line at the shoulders, is formed into the similitude of the letter W. The beetle may be expected to appear in April and May and deposit its eggs in the rough bark. Upon hatching, the larvæ at once bore through into the sapwood where they feed for a while, later penetrating the solid heartwood. The pupa state is passed in the burrow.

REMEDIES.—When the borers are once beneath the bark they are difficult to destroy. Flexible wire probes thrust into the burrows can be used to kill some of them. Chloroform or carbon disulphide may be injected into the burrows by means of a spring bottom can, or wads of cotton may be saturated with these liquids and stuffed into the burrows, the outside openings to the tunnels being closed with clay-mud or putty to confine the fumes.

Should the insects become very numerous it will likely be best during April, May, June and possibly July to keep the trunks

and larger limbs coated with a repellant prepared as follows: dissolve one gallon of soft fish-oil soap in eight gallons of water and add one pint of crude carbolic acid, two or three pounds of lime and one-fourth pound of Paris green or white arsenic. Scrape the trees so as to remove all the rough bark possible and apply with a spray pump. The work can be done with a paint brush, but is slower. It may be necessary to make two or three applications to render the coating effective through so long a period. Chunks of hard whale oil soap fastened in the crotches of the trunk and larger limbs would be gradually dissolved by the rains and carried over the bark, thus affording a measure of protection.

THE WHITE ANT. (*Termes flavipes* Koll.)

All Floridians are familiar with these insects under the name of woodlice, white ants, or Termites. The orange growers have long known their capacity for mischief and the pecan orchardists as well must make their acquaintance. Thus far they have not caused much annoyance to the pecan men, I think, but are common enough to deserve mention.

They work in colonies and when they have once gained entrance to the heart of a growing tree are apt to destroy it by mining out the interior, while leaving the outside intact. Thus the damage they do is apt to elude observation. A careful look-out should be kept on trees planted on newly cleared land or land that has upon it a considerable amount of decaying wood, for here the insects are apt to be plentiful and may attack the newly planted trees.

REMEDIES.—White ants shun the light and hence can be greatly discouraged by the removal of the earth from about the attacked parts, thus exposing them to light and air. With a knife cut away so far as possible and remove all dead wood and bark, exposing the galleries. This treatment should be supplemented by following some of the succeeding directions.

If the nest can be reached, it may be deluged with boiling water or carbon disulphide may be poured into it and the earth banked over it until the fumes have reached the entire colony. Not more than one or two ounces of carbon disulphide should be

injected about the roots of a tree from two to three inches in diameter at the base. Larger trees can stand more, perhaps three or four ounces, the last figure being a large dose. A light, dry, loose soil, from which the liquid will evaporate readily, needs a larger dose than a heavy, moist soil. So far as possible give the treatment when the soil is dry and loose. The carbon-disulphide treatment is somewhat dangerous to the trees.

If the nest is outside the tree, a few holes may be opened to it with a sharpened stick into which the liquid is poured, the holes afterwards being closed. If the nest is inside the trunk, open holes to it with a gimlet or auger-bit and introduce the liquid with a medicine dropper or through a funnel. Some correspondents report good results from using tobacco dust plentifully in the nests and about the roots of attacked trees. Possibly cyanide of potassium, finely crushed, and scattered in the nests would be effective, since it is excellent for the destruction of the nests of genuine ants. Pyrethrum is known to be very effective against these insects and may be used like tobacco dust, mixed with the soil about the nest. Pyrethrum loses its efficacy in a few days.

When the bottoms of trees have been girdled or greatly weakened they may sometimes be helped by bridge grafts, that is scions may be inarched between the root below the wound and the bark above, thus re-establishing the connection between the two. The difficulty in making successful grafts of the pecan may render this attempt futile in many cases. However, it is, perhaps, feasible in most cases to plant young stocks close to the injured tree and graft in the stocks above the destroyed bark, thus sustaining the life of the trunk until the missing portion is replaced. In all cases it is wise to apply a poultice of cow dung to the wounded areas. A little tobacco dust mixed in with the dung would probably discourage any new coming ants from starting a colony in the poultice.

THE COTTONY SCALE.

(*Pulvinaria innumerabilis* Rathvon.)

In April and May this scale is conspicuous because of the large white cottony masses of fluff that cover the egg-sac. While

not usually a dangerous insect, at times it becomes sufficiently numerous to demand a little attention.

A single female lays from 1,000 to 2,000 eggs in the cottony covering, and the young, when hatched, fix themselves along the ribs of the leaves or upon the younger twigs. The winged males appear in midsummer, mate with the females and die. The females are attached to the twigs, usually to the underside during the winter.

NATURAL ENEMIES.—The two-stabbed lady-bug, *Chilocorus bivulnerus*, feeds upon the scale in all its stages. The carnivorous caterpillar, *Loetilia coccidivora*, feeds in the egg-nest, destroying nearly all the eggs in the mass before seeking a new lot of eggs. Very minute hymenopterous parasites can be bred from the insects in great numbers.

REMEDIES.—A little prompt pruning and burning in the spring as soon as the cottony masses appear will often save the need of later notice. When pruning would involve the destruction of too much wood or for any reason is impracticable, apply kerosene emulsion, diluted one to nine with water, with a spray pump or by means of a brush. Since the eggs are not killed it will be necessary to repeat the application two or three times at intervals of two or three weeks so as to destroy the young as fast as they appear. A single application can be made most effective by diluting the emulsion with soapsuds, one pound of whale-oil soap being dissolved in nine gallons of water for mixture with one part of emulsion. Apply thoroughly after the young begin to appear. The soap will mat the cottony fluff, rendering it difficult for the young to escape from the nest upon hatching from the eggs.

Any of the contact sprays, such as lime-salt-sulphur wash, whale-oil soap used at the rate of one pound in two or three gallons of water, or kerosene emulsion will be effective if applied in winter. Such sprays should not be used until the trees are thoroughly dormant, from midwinter until the buds commence to swell in spring, otherwise the nut crop may possibly be reduced because of injury to bloom buds.

THE PECAN EULECANIUM.

(*Eulecanium* sp.)

A soft, brownish, hemispherical scale insect, of rare occurrence on pecan. Should it ever become numerous, the remedies and treatment suggested for the preceding species will prove effective.

GENERAL PRACTICE IN THE PECAN ORCHARD.

An important means of overcoming insect attacks is to cultivate well and fertilize freely. Thrifty trees will grow and bear in spite of attacks that would kill trees already sickly; this is especially true when they are attacked by such insects as bark-borers. Spraying can hardly be omitted. Fungus diseases or blights as well as insect pests make this necessary. The lime-salt-sulphur wash is a fungicide as well as an insecticide and successfully controls some forms of leaf disease, such as peach curl. The following insects will probably be held in good control by making one or two sprayings during the dormant period: the bud-worm, the case-worm, coleophora, the cottony and all other scales; when leaf diseases are added, the advisability of using the wash is readily understood. Where this winter spraying has been done it is possible that summer treatment will be needed only in special cases. When the necessity is apparent, one or two sprayings with Bordeaux mixture, combined with arsenate of lead, will probably control fungus diseases and leaf-feeding insects for the remainder of the year.

SPRAYING AND SPRAYING APPARATUS.

Recipes for the different mixtures will be found in Bulletin 76 of the Florida Station and in Farmers' Bulletin No. 127 of the U. S. Department of Agriculture. A list of pump factories is given in Bulletin 76.

When trees are not over 30 feet high, the spraying can be done with elongated extension rods from an elevated platform built for the spray wagon. Descriptions of such outfits, with illustrations of them, are found in various publications, for example in the excellent bulletin on Insects Injurious to the Pecan, published by the Mississippi Experiment Station, Agricultural

therefore, do not fear for the future of the pecan business. The pecan is a close relative of the hickory and walnut, and for the most part has identically the same insect enemies. In the end, we expect the pecan to prove itself as hardy and as immune from insect attack as its relatives. Insect damage is probably worst while the young orchards are coming into bearing. The uninterrupted food supply furnished by large orchards composed wholly of pecans, encourages excessive multiplication of pests, while their natural enemies follow them more slowly, being unable to strike a balance until several years have passed. We believe it will be easier to grow pecans than apples or oranges, but pecan orchardists and nurserymen should familiarize themselves with pecan enemies in order to obtain most satisfactory results.

ACKNOWLEDGEMENTS.

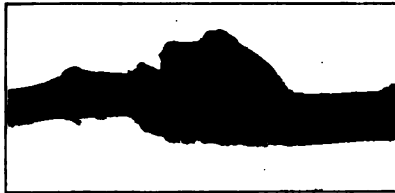
In the preparation of this bulletin I am specially indebted to Prof. F. C. Reimer who prepared a considerable number of the prints for the illustrations; to Mr. J. S. Houser who furnished negative of Catocala moth; to Prof. H. H. Hume for negatives of moth of case-bearer and of Pl. I; to Dr. L. O. Howard for determination of *P. conquisitor* and *S. vittata*; also for confirmation of determination of *P. deludana* and for other favors; to Dr. H. G. Dyar, through the kindness of Dr. Howard, for determination of *A. nebulella*; to Prof. G. W. Herrick for loan of figs. 4 and 5, Pl. V, and figs. 1 and 3, Pl. VII; to the pecan growers of Florida for ever ready help and cooperation; and to Dr. Andrew Sledd, Director of the Florida Station, whose interest and courtesy have made the publication possible.

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Cocoon of *Megalopyge opercularis* on Pecan twig. Not a serious pest.

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BULLETIN No. 80.—Special.

APRIL, 1905.

FLORIDA
AGRICULTURAL EXPERIMENT STATION
CHEMICAL DEPARTMENT

THE COMPOSITION OF SOME
OF THE CONCENTRATED
FEEDING STUFFS ON
SALE IN FLORIDA

A. W. BLAIR

The bulletins of this Station will be sent free to any address
in Florida upon application to the Director of the
Experiment Station, Lake City, Fla.

JACKSONVILLE, FLORIDA:
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1905

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THE COMPOSITION OF SOME OF THE CONCENTRATED FEEDING STUFFS ON SALE IN FLORIDA.

BY A. W. BLAIR.

The fact that Florida is largely a vegetable and fruit growing State, has seemed to render necessary the importation, from other states, of large quantities of concentrated feeding stuffs. I have no means of verifying the statement, but I believe that I am safe in saying that in proportion to the population, and the number of farm animals, no other State in the Union imports such large quantities of these materials for home consumption.

THE NECESSITY FOR A FEEDING STUFFS INSPECTION LAW.

The question as to the quality of these goods seems never to have troubled us seriously. We have been content to take what the manufacturer is pleased to send us, and if the quality has been poor, either the animals have suffered or we have been compelled to buy an additional quantity to compensate for the inferior quality, or both. On the other hand we have not been content thus to accept what the manufacturers of fertilizers were sending us, but have required them to state the ingredients used in the manufacture of the goods, and guarantee that they will, on analysis, show a certain percentage of the fertilizing constituents—plant food; and we have further clothed the State Chemist with power to collect and analyze samples and publish to the State the results of his work, in order that the farmer and fruit grower may be protected from the sale of adulterated goods.

But a large quantity, perhaps the largest quantity of commercial fertilizers used in the State is manufactured here, and to say to the fertilizer manufacturers of this State, "You must make your fertilizers, which you furnish us for growing our crops, come up to a definite guarantee," while we say to the manufacturers of concentrated feeding stuffs in other states (for practically all the ground products on the market come from other states), "you may send to us for feeding our stock whatever grade of goods you choose," does not seem entirely just to the manufacturer of fertilizers.

It is, perhaps, true that greater loss would result from the use of inferior fertilizers than from the use of inferior feeding stuffs, and that it is easier to practice deception with the former than with the latter, still this does not make it less important that he who buys feeding stuffs should be protected from inferior and fraudulent goods. The great variety of mixed feeds, and proprietary feeds, makes it comparatively easy to deceive, even those who have had considerable experience in handling such goods. How many of those who buy feeding stuffs can say that they do not contain ground corn cobs, rice hulls, corn bran, etc., any more than the farmer can say that his fertilizers do not contain low grade materials worth but little more than half the price asked for them? The fact that the following States, viz: Maine, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, North Carolina, Maryland, Tennessee, Indiana, Wisconsin, Pennsylvania, Louisiana and Ohio, now have feeding stuff laws in operation, would seem to indicate pretty clearly that there is need to guard against adulteration and fraudulent practice. This fact in itself ought to be sufficient to bring us to our senses; for we need not think for one moment that the manufacturers will stop placing upon the market inferior goods, so long as there are places like South Carolina, Georgia, Florida, and Alabama to be used as dumping grounds for what more than half the states east of the Mississippi will not have.

I recently wrote to the State Chemist of North Carolina to know if he thought the shutting out of adulterated goods from some of the states would tend to increase their sale in the states having no protection, and I herewith give his answer:

"I feel sure that the shutting out of adulterated goods in one State will increase their sale in others. We know of goods which were formerly much adulterated and sold in this State which now seek other markets."

To the same question the State Chemist of Maryland replied:

"It is reasonable to suppose that the shutting out of adulterated goods by inspection in some of the states would

tend to make such goods more abundant in other states where there is no inspection. I am sure that the amount of such goods is greatly decreased by inspection, but I have no way of proving that the goods are simply diverted to other channels."

With the mild climate and open winters which Florida possesses it is to be regretted that we do not produce more feeding materials at home, and thus to some extent, stop the flow of money out of the State. It has been fully demonstrated that crops can be grown here which will, to a considerable degree, take the place of the imported feeding stuffs. Among these may be mentioned velvet bean, cow pea, and beggar-weed hay; rye for winter grazing; and alfalfa, in addition to corn and oats.

In order to better understand the analytical results, it will be necessary to consider briefly the composition of feeding materials, and the terms used in discussing foods and feeding stuffs.

CLASSIFICATION OF FEEDING STUFFS.

In a general way, feeding stuffs may be classified as *protein* (nitrogenous) feeds; and *starchy* (carbohydrate) feeds; though this distinction is only relative, since there is no distinct dividing line between the two classes.

Nearly all contain both protein and carbohydrates, but those high in protein, like cotton seed meal, linseed meal, gluten meal, and a number of others, are usually classified as protein feeds; while those low in protein and high in carbohydrates, like corn, corn and cob meal, oats, barley and others, represent the starchy or carbohydrate feeds.

Each class of substances has a distinct office to perform in the animal organism, and it is important that the purchaser should understand something of the uses of these two classes, and have a fair knowledge of the amount of each contained in the various feeding stuffs, so that he may purchase that which he most needs, and at the same time that which is most economical.

TERMS USED IN DISCUSSING FOODS AND FEEDING STUFFS.

By chemical analysis, feeding stuffs are separated into six classes of substance, viz: Water, ash, protein, fiber, nitrogen-free extract and fat.

Water is contained in all feeding stuffs, even the dryest hays and grains, and varies from 8 to 15 per cent, in this class to 80 per cent in silage, and 90 per cent in some roots.

Ash is left when the combustible part of a feeding stuff is burned away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorine, and carbonic, sulphuric, and phosphoric acids, and is used largely in building up the bony structure.

Protein (nitrogenous matter) is the name of a group of substances containing nitrogen. Protein furnishes the material for the lean flesh, blood, skin, muscles, tendons, nerves, hair, bones, wool, casein of milk, albumen of eggs, etc., and is one of the most important constituents of feeding stuffs.

Crude Fiber (cellulose) is the frame work of plants, and is, as a rule, the most indigestible constituent of feeding stuffs. The coarse fodders, such as hay and straw, contain a much larger percentage of fiber than the grains, oil cakes, etc.

Nitrogen-Free Extract includes starch, sugar, gums, and the like, and forms an important part of all feeding stuffs, but especially of most grains.

Fat, or the materials dissolved from feeding stuffs by ether, is a substance of mixed character, and may include, besides real fats, wax, the green coloring matter of plants, etc. The fat of food is either stored up in the body as fat or burned to furnish heat and energy. The crude fiber and nitrogen free extract, taken together, make up what are known as the carbohydrates. Fats and carbohydrates perform the same office in the body—those of the production of heat and force, or energy—that is, they keep the body warm and the machinery running. For this purpose one pound of fat is considered equivalent to about two and one-fourth pounds of carbohydrates.

NECESSITY FOR HOME-GROWN FEEDING MATERIALS.

Feeding stuffs supplying these starchy substances, such as corn, oats, velvet bean, cow pea, and beggarweed hay, can be successfully grown in Florida; and when it becomes necessary to supplement these, as in many cases it does, with imported feed stuffs, only those should be imported which are much higher in protein than the home-grown products.

Obviously, then, it is poor economy to import from other sections of the country feeding stuffs low in protein—the most expensive and important ingredient—when they can be produced at home at less cost.

But that is just what Florida is doing. Many thousands of dollars are being sent out of the State for feeding stuffs, the equivalent of which can and should be produced within our own borders; and many more thousands are being spent for materials, which, when true to name, are fairly rich in protein, but which come to us below the standard quality, and which should, therefore, be subject to a law similar to that which prevents the sale of inferior fertilizers in the State.

INVESTIGATION OF FEEDING STUFFS NOW ON THE MARKET.

Believing that this condition existed, the Chemical Department of the Experiment Station began, last November, an investigation with a view to ascertaining the exact extent to which low grade and adulterated feeding stuffs are being placed upon the market.

Samples were secured from the various sections of the State, largely through students of the University who went to their homes at the Thanksgiving and Christmas vacations.

They were instructed to secure samples of the different concentrated feeds, which should, so far as possible, represent the whole lot from which they were taken, and also to secure the trade name, name and location of the manufacturer, and the selling price per sack of 100 pounds, or per ton, in the case of wholesale dealers. The names of dealers are reserved, since it is not intended to work any hardship to the wholesaler or retailer, so long as there is no law requiring them to maintain a certain standard.

As a result of this, forty-three samples, representing a considerable variety of feeding stuffs, and collected from different parts of the State, have been analyzed. It would have been much better could the number of samples and localities represented been greater, but the limited time and pressure of other work did not permit this.

It is believed, however, that the work represents, fairly well, the feeding stuffs on sale throughout the State.

In passing judgment on the quality of feeding stuffs, the percentage of protein and fat serve as an index, in the majority of cases, and in order that the results obtained may be more intelligently studied, a table (Table 1) showing the standard amounts of these substances in some of the more important feeding stuffs, is given:

TABLE I.—FEED STANDARDS.*

FEED STUFFS.		PER CENT PROTEIN	PER CENT FAT
<i>Protein Feeds.</i>	<i>Blood meal,</i>	85	0.2
	<i>Cottonseed meal,</i>	43	9
	<i>N. P. linseed meal,</i>	38	2
	<i>O. P. linseed meal,</i>	32	6
	<i>Gluten meal,</i>	35	1
	<i>Gluten feed,</i>	25	3
	<i>Germ oil meal,</i>	25	10
	<i>Distillers' dried grains,</i>	32	10
	<i>Malt sprouts,</i>	25	1
	<i>Brewers' dried grains,</i>	22	5
	<i>Wheat middlings (flour),</i>	18-20	5
	<i>Wheat middlings (standard),</i>	17-19	5
	<i>Mixed feed,</i>	16-18	4.5
	<i>Wheat bran,</i>	15-17	4.5
	<i>Dairy feeds,</i>	17-19	4-5
	<i>Oat middlings,</i>	16	6
	<i>Rye feed,</i>	15	3
<i>Starchy (Carbohydrate) Feeds.</i>	<i>Ground oats,</i>	11	4
	<i>Ground wheat,</i>	11	2
	<i>Barley meal,</i>	11	1.5
	<i>Rye meal,</i>	10	1.5
	<i>Corn meal,</i>	9	3
	<i>Hominy meal,</i>	10.5	7.5
	<i>Provender,</i>	10	3.5
	<i>Corn and oat feed,</i>	8-10	3-5
	<i>Fortified oat feed,</i>	12-14	3-5
	<i>Oat feed,</i>	5-8	2
	<i>Corn bran,</i>	9	5
	<i>Dried molasses-beet-pulp,</i>	9	0.3
<i>Poultry Feeds.</i>	<i>Meat scraps,</i>	50	12-15
	<i>Meat and bone meal,</i>	35	10
	<i>Bone,</i>	25	—
	<i>Poultry mash and meal,</i>	13-16	4-5
	<i>Chick and scratching grain,</i>	9-11	2-3
	<i>Clover meal,</i>	12	2

*Bulletin No. 98, Massachusetts Experiment Station.

From this it will be seen that cotton seed meal, for example, to be standard, should contain 43 per cent of protein and 9 per cent of fat; that wheat bran should contain not less than 15 per cent of protein and 4.5 per cent of fat; and that ground oats should contain 11 per cent of protein and 4 per cent of fat.

These standards have been made up from a large number of analyses made by State Experiment Stations and the United States Department of Agriculture, extending over a period of several years. According to Dr. Langworthy of the United States Department of Agriculture, 11,749 analyses of feeding stuffs have been published since July 31st, 1900.

Table II gives the average composition of a number of American feeding stuffs, and will further aid in the study of the results obtained at this Station.

TABLE II.—AVERAGE COMPOSITION OF SOME AMERICAN FEEDING STUFFS.*

	Water %	Ash %	Protein %	Fiber %	Nitro- gen- free Extract %	Fat %
<i>By Products.</i>						
Cottonseed Meal.....	6.8	6.2	45.6	5.4	25.2	10.8
Linseed Meal, old process.....	8.3	5.3	35.7	7.5	36.0	7.2
Linseed Meal, new process.....	10.0	5.2	36.1	8.4	36.7	3.6
Wheat Bran.....	11.9	5.8	15.4	9.0	53.9	4.0
Wheat Middlings.....	10.0	3.8	17.4	5.2	58.0	5.6
Wheat Shorts.....	11.8	4.6	14.9	7.4	56.8	4.5
Brewers' Grains, dried.....	8.2	3.6	19.9	11.0	51.7	5.6
Oat Feed.....	7.7	3.7	16.0	6.1	59.4	7.1
Oat Hulls.....	7.3	6.7	3.8	29.7	52.1	1.0
Gluten Feed.....	7.8	1.1	24.0	5.3	51.2	10.6
Corn Bran.....	9.1	1.3	9.0	12.7	62.2	5.8
Corn Cob.....	10.7	1.4	2.4	30.1	54.9	.5
<i>Mill Products.</i>						
Corn Meal.....	15.0	1.4	9.2	1.9	68.7	3.8
Corn and Cob Meal.....	15.1	1.5	8.5	6.6	64.8	3.5
Ground Corn and Oats, equal parts	13.0	2.2	10.5	5.7	64.2	4.4
<i>Grain and Other Seeds.</i>						
Corn.....	10.9	1.5	10.5	2.1	69.6	5.4
Cottonseed (whole with hulls)...	10.3	3.5	18.4	23.2	24.7	19.9
Cow Pea.....	14.8	3.2	20.8	4.1	55.7	1.4
Velvet Bean†.....	11.5	3.2	22.7	7.5	48.5	6.6
Soy Bean.....	10.8	4.7	34.0	4.8	28.8	16.9
<i>Hay and Dry Coarse Fodder.</i>						
Timothy Hay.....	13.2	4.4	5.9	29.0	45.0	2.5
Italian Rye Grass.....	8.5	6.9	7.5	30.5	45.0	1.7
Crimson Clover.....	9.6	8.6	15.2	27.2	36.6	2.8
Alfalfa.....	8.4	7.4	14.3	25.0	42.7	2.2
Cow Pea Hay.....	10.7	7.5	16.6	20.1	42.2	2.2
Oat Straw.....	9.2	5.1	4.0	37.0	42.4	2.3
Soy Bean Hay.....	11.3	7.2	15.4	22.3	38.6	5.2
Beggarweed Hay‡.....	10.2	10.9	21.7	24.7	30.2	2.3
Velvet Bean Hay†.....	7.2	5.7	14.7	29.7	41.0	1.7
Wire Grass Hay‡.....	8.8	3.8	5.5	31.8	48.6	1.5

*From W. H. Jordan's, The Feeding of Farm Animals.

†Bulletin No. 60, Florida Experiment Station.

‡Unpublished Analyses Florida Experiment Station.

The figures for the beggarweed hay, in Table II, represent the average of three hitherto unpublished analyses of hay grown on good soil and cut at the proper time to give the best results. Other samples taken from the same plot, but cut at different times, and also samples of hay from other lots, show decidedly less protein—8 to about 16.5 per cent—though do not vary so much in fat content.

However, there seems little doubt but that with the proper care, beggarweed hay can be grown that will yield 15 per cent protein and 2 per cent of fat, and this compares very favorably with crimson clover and alfalfa.

The figures for velvet bean hay represent an analysis of hay cut at the proper season, and the protein content, as in case of the beggarweed hay, is somewhat higher than the average velvet bean hay would show. The analyses of these materials are given in order that their feeding value may be compared with the feeding value of the concentrated materials reported in this bulletin.

TABLE III.—ANALYSES OF CONCENTRATED

Laboratory Number	BRAND NAME	NAME OF MANUFACTURER	ADDRESS OF MANUFACTURER	SAMPLE TAKEN AT
1702	Wheat Bran	Cumberland Mills	Nashville, Tenn	Lake City
1713	" "	Ballard & Ballard	Louisville, Ky	" "
1714	" "	Liberty Mills	Nashville, Tenn	" "
1716	" "	" "	" "	" "
1722	" "	Etowah Mills	Cartersville, Ga	College Farm
1726	" "	Mountain City Milling Co.	Chattanooga, Tenn	Palatka
1730	" "	" " " "	" " " "	Jasper
1731	" "	" "	" "	" "
1799	" "	" "	" "	Jacksonville
1804	" "	Southern Milling Co.	Nashville, Tenn	Key West
1807	" "	Cumberland Mills	" "	West Palm Beach
1831	" "	Etowah Milling Co.	Cartersville, Ga	Kissimmee
1715	Shorts	Liberty Mills	Nashville, Tenn	Lake City
1725	" "	Marcus Burnheimer	St. Louis, Mo	Palatka
1729	" "	" "	" "	Jasper
1732	" "	Cumberland Mills	Nashville, Tenn	Jacksonville
1802	Middlings	Southern Milling Co.	" "	Key West
1808	Shorts	" "	" "	Lealman
1809	" "	" "	" "	" "
1830	" "	Etowah Milling Co.	Cartersville, Ga	Kissimmee
1718	Purina Feed	" "	" "	Tampa
1734	" "	Ralston Purina Co.	St. Louis, Mo	Jacksonville
1800	" "	" " " "	" " " "	Hallandale
1801	" "	" " " "	" " " "	Dania
1806	" "	" " " "	" " " "	West Palm Beach
1828	" "	" " " "	" " " "	Kissimmee
1717	Victor Feed	" "	" "	Tampa
1727	" "	American Cereal Co.	Chicago, Ill	Palatka
1735	Victor Corn and Oat Chops	" " " "	" " " "	Jacksonville
1798	Victor Corn and Oat Feed	" " " "	" " " "	" "
<i>Miscellaneous Protein Feeds.</i>				
1723	Cottonseed Meal	Ga. Cotton Oil Co.	Macon, Ga	Palatka
1728	Crushed Cottonseed	" "	" "	Jasper
1736	Steam Cooked Feed	American Steam Feed Co.	Nashville, Tenn	Jacksonville
1805	Yellow Meal	Cotton Oil Company	Jacksonville, Fla	Key West
<i>Miscellaneous Carbohydrate Feeds.</i>				
1719	Boss Feed	" "	" "	Tampa
1720	Parcell Feed	" "	" "	" "
1721	Corn and Cob Meal	Prepared on Station Farm	" "	Station Farm
1724	Ship Stuff	Mountain City Mills	Chattanooga, Tenn	Palatka
1733	Hudnut's Feed Meal	" "	" "	Jacksonville
1737	Mack's Mule Feed	Sample obtained of Broker	" "	" "
1738	Atlas Dairy Feed	Atlas Dairy Food Co.	New Orleans, La	" "
1803	Cow Feed	Southern Milling Co.	Nashville, Tenn	Key West
1829	Marsden Food	Marsden Food Co.	Chattanooga, Tenn	Kissimmee

*Could not be obtained.

FEEDING STUFFS ON SALE IN FLORIDA.

Laboratory Number	ANALYSES						Retail Price per sack of 100 lbs.	Price per ton
	Water %	Ash %	Protein %	Crude Fiber %	Nitrogen-free Extract %	Fat %		
1702	12.85	6.23	14.38	9.19	53.08	4.27	\$1.35	\$26.00
1713	12.25	5.77	14.44	9.00	54.89	3.85	1.35	*
1714	12.34	6.76	14.56	9.38	53.09	3.87	1.25	*
1716	12.20	6.30	14.88	9.35	52.76	4.51	1.40	*
1722	11.62	6.00	14.44	9.49	54.28	4.19	*	24.00
1726	12.32	6.89	12.81	12.21	52.16	3.61	*	21.00
1730	11.87	6.20	11.88	11.96	53.43	4.66	*	24.00
1731	12.09	6.13	12.38	12.60	52.78	4.02	1.25	*
1799	11.94	3.90	9.44	17.04	55.56	2.12	1.20	23.00
1804	12.01	6.10	14.94	6.67	55.94	4.34	1.50	23.00
1807	11.28	5.30	13.06	7.94	58.84	4.08	1.75	22.00
1831	12.88	5.24	13.75	9.36	55.20	3.57	*	22.50
verage	12.13	5.90	13.41	10.35	54.27	3.92	1.38	22.78
1715	12.81	4.37	17.75	5.24	54.14	5.69	1.50	*
1725	13.16	4.29	16.31	6.10	55.38	4.76	*	25.00
1729	12.62	3.19	15.31	3.43	61.77	3.68	1.35	*
1732	12.62	4.67	11.41	7.81	59.60	3.89	1.40	*
1802	12.72	3.90	16.50	5.15	56.14	5.59	1.85	27.00
1808	12.80	4.08	17.01	5.11	55.56	5.44	1.45	*
1809	11.35	4.20	17.98	5.35	54.70	6.42	1.45	*
1830	13.42	3.59	15.44	5.41	57.63	4.51	*	26.00
verage	12.68	4.03	15.96	5.45	56.86	5.00	1.50	26.00
1718	10.41	4.50	10.81	12.85	57.65	4.28	*	*
1734	10.97	4.24	10.41	10.43	60.29	3.66	1.35	26.00
1800	11.47	6.44	9.16	15.89	58.37	3.67	1.85 to 1.90	*
1801	11.24	7.20	8.47	16.72	53.08	3.34	1.85	37.00
1806	10.43	6.68	9.08	15.78	54.62	3.41	*	27.00
1828	10.81	6.46	9.15	15.57	54.11	3.90	*	28.00
verage	10.89	5.92	9.43	14.54	55.51	3.71	1.68	29.50
1717	10.85	3.66	7.75	14.61	60.63	2.50	*	*
1727	11.17	3.50	7.62	13.98	59.93	3.80	*	24.50
1735	10.70	3.87	8.03	12.99	61.97	2.44	1.35	25.00
1798	11.71	3.40	7.09	13.69	60.66	3.45	1.80	26.00
verage	11.11	3.61	7.62	13.82	60.80	3.05	1.32	25.16
1723	10.33	5.68	41.87	7.43	25.71	8.98	*	*
1728	9.60	4.33	20.44	16.40	26.49	22.74	*	20.00
1736	11.51	6.05	25.16	9.33	43.70	4.25	1.40	*
1805	9.64	4.81	29.59	13.14	26.78	16.04	1.80	27.00
verage	10.27	5.22	29.26	11.57	30.67	13.00	1.60	23.50
1719	10.37	4.60	7.44	19.64	56.14	1.81	*	*
1720	11.79	2.90	10.50	7.76	63.16	3.89	*	*
1721	11.86	1.46	8.56	6.78	66.84	4.50	*	20.00
1724	12.33	7.55	13.00	13.01	50.46	3.65	*	25.00
1733	10.34	2.90	10.88	3.34	62.67	9.87	1.35	*
1737	9.60	7.91	6.47	22.25	52.27	1.50	1.30	*
1738	9.77	6.93	12.21	14.76	53.35	2.98	1.35	26.00
1803	11.78	2.90	10.38	6.06	60.90	7.98	1.80	25.00
1829	9.42	4.15	4.56	36.11	45.04	.72	*	16.20
verage	10.81	4.59	9.33	14.41	56.76	4.10	1.45	22.44

DISCUSSION OF RESULTS.

In Table III will be found the results of the work done at this Station. By referring to the column headed "address of manufacturer," it will be seen that of all the samples where the address could be obtained, only one, number 1805, was prepared in this State.

This is to be expected to a certain extent, since Florida is not a grain-growing State, but it emphasises very clearly the necessity for the greater home production of such grains and hays as can be produced here. And especially is it necessary if the State is to continue to be flooded with inferior goods, that the markets north of us will not have.

BRAN.

Taking up first the brans and comparing their protein and fat content with the standard in Table I, we find that all of the samples examined fail to come up to the minimum standard requirement in protein—15 per cent; the closest approach to this standard being number 1716, with 14.88 per cent protein, while the average protein for the twelve samples is 1.6 per cent below the minimum standard, and 2 per cent below the average of American feeding stuffs.

Only two samples, 1716 and 1730, come up to the standard in fat, while one of these, 1730, is 3 per cent below the minimum protein standard.

Number 1799 is very low in protein and fat, while the fiber—the indigestible part—is over 17 per cent, whereas, in good wheat bran it should not much exceed 9 per cent. It is to be noted that the price in this case is somewhat lower than the price of other goods which approach more nearly to pure wheat bran, but if the price had been reduced in proportion to the protein it would have been sold for eighty-five to ninety-five cents per 100 pounds. This sample was highly adulterated with ground corn cobs and screenings.

Number 1714 contained wheat chaff, corn bran, and various pieces of foreign matter, indicating mill sweepings. Numbers 1726, 1730, and 1731 contained corn bran; 1807, dirt and oat chaff, and 1831, chaff, corn bran and other foreign matter, probably mill sweepings. The average retail price

for eight of the twelve samples is \$1.38 per sack of 100 pounds, which is undoubtedly excessive when it is remembered that not one of the samples comes up to the minimum standard for pure wheat bran.

SHORTS.

With one exception, the seven samples of shorts examined are of good quality, and three of them are sufficiently high in protein and fat, to indicate that they may have been middlings, though reported as shorts. The exception, 1732, is adulterated with rice hulls, the effect of which is noticed in the low protein and high fiber. Two other samples, 1725 and 1729, contained foreign matter; the first weed seeds and the second ground corn. The sample reported as middlings is of fair quality, though not up to the standard.

CORN AND OAT FEEDS.

Six samples of Purina, four of Victor and one each of Boss, Parcell and Mack's Mule Feed, are corn and oat feeds, and are composed of cracked corn, ground or crushed oats and oat hulls, the oat hulls in most cases predominating. These are no doubt, the product of cereal food mills, and furnish a means of disposing of the oat hull at a good profit. They have a fair feeding value, though in most cases this is not in proportion to the price asked for them. Certainly this can be said of those obtained at Dania and Hallandale. By referring to Table II it may be seen that oat hulls contain only 3.3 per cent of protein and 1 per cent of fat.

The average protein content of the four samples of Victor Feed is only 7.62 per cent, while the fat is 3.05 per cent, and in this connection it is interesting to note that five samples of Victor corn and oat feed manufactured by the American Cereal Company and analyzed at the New Jersey Station, gave an average of 8.64 per cent of protein and 4.50 per cent of fat, and five samples analyzed at the Connecticut Station gave 8.26 per cent protein and 3.93 per cent of fat, and sold at an average price of \$25.40 per ton. Both New Jersey and Connecticut have inspection laws.

The sample of Mack's Mule Feed is very low in protein and fat, and high in crude fiber and ash, indicating clearly the predominance of oat hulls. Referring again to Table II, it will be seen that ground corn and oats, equal parts, should contain 10.5 per cent protein and 4.4 per cent fat.

MISCELLANEOUS FEEDS.

Number 1805, sold under the name of Yellow Meal, is cotton seed meal adulterated with hulls, making the protein content about 13 per cent lower than it should be, for the price asked—\$27.00 per ton.

Number 1736, Steam Cooked Feed, is malt sprouts, and, judged by the high protein content, should be a good feeding material.

Numbers 1733 and 1803, Hudnut's Feed Meal and Cow Feed, respectively, are hominy meal, and have a slightly higher feeding value than corn meal.

The cow feed is adulterated with a small amount of ground corn cobs and the small ends of the grains.

The corn and cob meal, 1721, was analyzed in order that it might be compared with other feeding materials.

Atlas Dairy Feed, number 1738, is a product of the sugar factories, and is made by drying and grinding the bagasse, soaking in molasses, and again drying. Its value, as a feeding material, is probably not yet well established in this State.

Marsden Food, number 1829, is ground straw, probably oat straw, and has about the feeding value of oat straw, see analysis Table II. The price, \$16.20 per ton, is unreasonable.

The wire grass hay which grows abundantly in the pine woods of Florida, contains more protein and more than twice as much fat (see analysis Table II) as does this material, and would no doubt be about as easily digested. But either beggarweed, cow pea, or velvet bean hay contains anywhere from two to five times as much protein, and would certainly not cost any more, if as much, as does this high-sounding "Marsden Food."

SUMMARY.

Judged by the samples examined, a large proportion of the concentrated feeding stuffs on the Florida market is of an inferior quality.

All of the samples of wheat bran examined are below the minimum standard for good wheat bran.

Some materials, as "Marsden Food," are sold at unreasonably high prices.

The adulterants found where rice chaff, wheat chaff, oat hulls, ground corn cobs, corn bran, screenings, weed seeds, dirt and other foreign matter, indicating mill sweepings.

Practically all the concentrated feeding stuffs used in this State are imported, and this constitutes a constant drain upon the wealth of the State.

Florida can and should produce much more of her feeding materials than she is producing, and thus save to the State thousands of dollars. Where the farm crops furnish sufficient carbohydrates, only feed stuffs rich in protein should be purchased. The mixtures of corn and oats, containing, as they do, large quantities of oat hulls, are not economical protein feeds.

There is so much profit in selling ground corn cobs, wheat chaff, oat hulls, corn bran, rice hulls, etc., at the price of wheat bran, that the consumer must ever be on the watch. A careful examination with the eye or with the help of a small magnifying glass will often reveal these adulterants.

Those who buy feeding stuffs should have the same protection as those who buy fertilizers. Such protection would promote the interests of the honest manufacturer and dealer, diminish the sale of worthless materials, and instruct the people in regard to the composition of feeding stuffs and their comparative value.

METHODS OF ANALYSIS.

The methods of analysis followed were those adopted by the Association of Official Agricultural Chemists.

ACKNOWLEDGMENTS.

I am greatly indebted to Mr. R. A. Lichtenthaler, of this department, for a large part of the analytical work reported in this bulletin.

The following publications of the Florida Experiment Station are available for free distribution, and may be secured by addressing the director of the Experiment Station, University of Florida, Lake City, Fla.:

22 Fertilizers	pp. 48	57 Top-working of Pecans	pp. 124
24 Annual Report	" 32	58 Pomelos	" 43
25 Leeches and Leeching ..	" 17	59 Cauliflower	" 20
26 Big Head	" 19	60 Velvet Beans	" 24
27 Pineapple	" 11	61 Two Peach Scales ...	" 32
28 Liver Fluke—Southern		62 Peen-to Peach Group ..	" 22
Cattle Fever	" 15	63 Packing Citrus Fruits .	Folio
29 The San Jose Scale ...	" 28	64 Texas Fever and Salt	
30 The Culture of Tobacco "	" 28	Sick	" 31
32 Cotton and Its Cultiva-		65 The Kumquats	" 14
tion	" 4	66 The Mandarin Orange	
33 Orange Groves	" 33	Group	" 32
34 Insect Enemies	" 96	67 The White Fly	" 94
36 Insects Injurious to		68 Pineapple Culture. I.	
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37 Pineapple	" 15	69 Cultivation of Citrus	
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39 Strawberries	" 48	70 Pineapple Culture. II.	
40 The Fall Army Worm "	" 8	Varieties	" 32
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BULLETIN NO. 81

AUGUST, 1905

Florida
Agricultural Experiment Station
Chemical Department

Fertilizer Suggestions

E. R. FLINT

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FERTILIZER SUGGESTIONS.

BY E. R. FLINT.

The formulas and suggestions in this Bulletin have been compiled from experiments made at this and other Stations at various times, especially those of neighboring States on the subject of fertilization, in response to frequent inquiries for general and special formulas. Modified, when necessary, for individual cases and conditions, they should give good results.

INTRODUCTION.

When the German and French scientists, in the early part of the last century, first began to study plant feeding, they found that the only way they could control their observations was by growing plants in a soil that contained no plant food, as pure quartz sand or finely cut platinum wire, and then adding what was necessary. It was thus discovered that a certain small amount of mineral constituents were as necessary to plant growth as is sufficient oxygen, carbon dioxide and moisture which the plant derives from the air, and that plants as well as animals would soon sicken and die if all mineral constituents were removed from the food.

Following this discovery, the belief rapidly gained ground that it was only necessary to supply large amounts of mineral plant food to the soil in order to get large crops. In late years, however, we are beginning to realize that this problem is not so simple as it at first appeared, and that many conditions affect the taking up of food by the plant from the soil. To be sure, the food must be there, but many other things must be taken into consideration, some within our control and some not, as to whether the plant can get the benefit of this food and give the return in the crop for the money expended in feeding it. These conditions and their control are receiving more and more attention every year. Among these problems may be mentioned the chemical changes that take place in the soil in regard to the plant food. We recognize the harmful effects to health of small amounts of preservatives in our canned goods, etc., and it is just as true that

small amounts of certain chemical compounds can develop in soils which injure the plant or prevent its getting the full value of the food present. Thus, the degree of acidity of a soil may exert a very potent influence on the crop, and on a strongly acid soil, any amount of certain forms of fertilizer might be applied without getting the benefit from it in the crop. Thus it is just as important that the farmer should know the general character of his soil as it is for him to know the best fertilizer formula for the crop he desires to raise.

Another point of the greatest importance is the amount and the movement of water in the soil. The ability of the plant to take up its food depends very largely upon this condition. The food must not only be present and in such chemical combination that it can be taken up by the plant without injury, but it must be distributed through the soil where the plant roots can find it. Otherwise you have the same condition as an animal tied up in a stall in a barn overflowing, perhaps, with food. The result is, that unless the food is brought to it, it dies of starvation. Exactly the same thing may happen to the plant if there is not sufficient water in the soil to bring the food to it. On the other hand, the soil may be in such a condition that the water drains off so rapidly and completely that much of the plant food is carried away in solution before it can be taken up by the plant. It will thus be seen that this problem is one of the greatest importance to the farmer, and as necessary for him to have some knowledge of as is the question of what fertilizer to apply and how much. To a considerable extent, the amount and movement of water in the soil is under control by proper cultivation, drainage or covering the surface with a growing crop. The more the farmer will study this phase of the problem on his own particular soil, the more successful will he be and the more economically will he be able to fertilize his crops. This feature differs with every varying condition of elevation, subsoil, etc., and it is only by constant study and experiment that a farmer can come to understand his soils.

Other factors that enter into the problem are climate, the amount of rainfall and sunshine, length of the seasons, and, to some extent, electrical conditions. These are not so much under control, further than the selection of such crops as are suited to the prevailing climatic conditions and proper cultivation.

It will thus be seen from the foregoing considerations that it is impossible to construct a fertilizer formula for any particular crop, even by taking the chemical composition of the plant and other factors at our command as a basis, as the availability of the different fertilizing ingredients on the market, etc., which will answer in all cases. One man may use a formula derived in this way with success, and on an adjoining field, with the same crop and formula, there may not be more than half the yield, because other conditions were unfavorable. Nevertheless, a scientifically constructed formula has a certain value, and it is at least better than an improperly balanced fertilizer. But one cannot always predict that it is the best formula to use on any given soil. For this reason, every progressive farmer should make tests of his own to determine just what his individual soil requires and should aim to make the physical condition of his land such as to get the most benefit from the fertilizer applied.

The agriculturalist of Florida is in much the same position as the early investigators, the larger portions of the soils of the State being sandy with very little plant food. In a general way, we speak of a fertile soil as one that is in a proper physical condition to produce a good crop, with perhaps moderate fertilization, and where the climatic and other conditions are favorable. If a non-fertile soil has the proper physical and climatic conditions it can be brought to a state of fertility by the application of sufficient and proper plant food. A chemical study of some of the typical soils of the State which was made by this Station in 1897 and published in Bulletin 43, shows the following average analysis of samples of sandy soils gathered from the central and southern portions of Florida:

Nitrogen.....	.0413 per cent.
Potash.....	.0091 per cent.
Phosphoric acid.....	.1635 per cent.
Lime.....	.2805 per cent.

Prof. Hilgard estimates that soils should contain the following amounts of the above ingredients in order to be classed as a fertile soil:

"The *lime* percentage should not fall below 0.1 per cent. in the lightest sandy soils; in clay loams not below 0.25 per cent., and in heavy clay soils not below 0.5 per cent.; and it may advantageously rise to 1 and even 2 per cent. as a maximum. Be-

yond the latter figure it seems in no case to act more favorably than a less amount, unless it be mechanically.

"The percentage of *phosphoric acid* is that which, in connection with the lime, seems to govern most commonly the productiveness of our virgin soils. In any of these, less than .05 must be regarded as a serious deficiency, unless accompanied by a large amount of lime. In sandy loams, 0.1 per cent., when accompanied by a fair supply of lime, secures fair productiveness for from eight to fifteen years; with a deficiency of lime, twice that percentage would only serve for a similar time.

"The potash percentages of soils seem, in a large number of cases, to vary with that of 'clay;' that is, in clay soils they are usually high, in sandy soils low; and since subsoils are in all ordinary cases more clayey than surface soils, their potash percentages are almost invariably higher.

"The potash percentage of heavy clay upland soil, and clay loams, ranges from about 0.8 to 0.5 per cent.; lighter loams from 0.45 to 0.30 per cent.; sandy loams below 0.3 per cent. and sandy soils of great depth may fall below 0.1 per cent. consistently with good productiveness and durability. Virgin soils falling below 0.6 per cent. in potash seem in most cases to be deficient in available potash, its application to such soils being followed by an immediate great increase of production. Sometimes, however, a soil very rich in lime and phosphoric acid, shows good productiveness, despite a very low potash percentage, and conversely, a high potash percentage seems capable of offsetting a low one of lime."

By comparing these figures with the average analysis of the sandy soils of Florida given above, it will be seen that they are very deficient in nitrogen and potash, and experience has shown that these elements in particular, with a fair amount of phosphoric acid, must be supplied in order to grow good crops. The per cent. of lime varies largely in soils and where it is low, an occasional application would undoubtedly show good results. The importance of lime has, up to within the last few years, been neglected as a fertilizing constituent. In this connection I quote from Oscar Loew, in "The Physiological Role of Mineral Nutrients," bulletin 18 of the Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture :

"The more leaf surface is developed in a given time, the more lime is necessary. A normal crop of wheat requires, per hectare (nearly 2.5 acres) about 25.57 pounds, sugar beets 66.58 pounds, grass 108.91 pounds, clover 246.47 pounds, tobacco 338.85 pounds, while a normal growth of wood needs annually about 44.1 pounds of lime besides 15 to 35 pounds of magnesia, 4 to 22 pounds of potash and 1.75 to 8.81 pounds of phosphoric acid. When the large demand for lime salts is taken into consideration it is easily understood that an absence or deficiency of lime becomes apparent very early. Corn shoots kept alive for some time in a culture solution free from lime, but all development gradually ceased with the consumption of the stored-up lime. However, when at the end of several weeks some lime was added a very striking effect was noticed, hardly five hours elapsing before new buds pushed out from the sickly looking tips."

Chemical examination will show the presence or absence of lime in a soil, but it is always a valuable test for the farmer to make, to lime a small experimental plot at least, and compare the results with the rest of the field, unless it is known that abundant lime is present. Other mineral ingredients, as iron, sulphur, magnesia, silica, etc., while just as essential to the plant, are required in small amounts and are generally present in all natural soils in sufficient quantity, so that they are left out of consideration in making up a fertilizer formula.

The question is often asked of the Station "what shall I use for a fertilizer to improve my land?" This question, in this form, without further knowledge of the conditions cannot be answered intelligently. One should know the altitude of the land, whether low and moist or high and dry, whether sandy, clayey or muck, the crop to be raised, etc., before deciding as to what fertilizing material would be best.

Soil fertility is further closely related to the amount and condition of the humus in the soil. This is one of the products of the partial decomposition of organic matter and plays an important part in the chemical changes going on in the soil and under certain conditions it may react injuriously. It not only improves the physical condition of the soil, especially in regard to its permeability and absorptive power but by its decomposition it supplies nitrogen to the plant and also forms certain acids which

are probably of considerable value in making the fertilizing elements in the soil available to the plant.

Still another important feature in the management of soils to improve their fertility, is the rotation of crops. The continuous growing of the same crop on a soil not only rapidly exhausts it of the special requirements of that crop, but there is very apt to be an accumulation of bacterial and other enemies to the plant in the soil which produce disease.

With a given formula at hand, the grower must next decide whether he will select a mixed fertilizer which comes approximately near it in composition and in which the guaranteed sources of the different ingredients are satisfactory, or whether he will buy his raw materials and mix them himself. If bought of reputable dealers, there is no doubt that mixed fertilizers, if properly selected, will give good satisfaction as a rule, but it is also true that home mixing is more economical, especially where several farmers club together to buy their raw material in sufficient quantities to get the lowest wholesale price. The labor involved is not very great and one is sure of the materials that enter into his fertilizers. The selling of raw materials to be mixed at home is becoming an important part of the fertilizer dealer's business. In mixing any given formula at the farm, with the concentrated materials generally used to supply the plant food, a saving of 100 to 200 pounds or more per ton can generally be made, which the manufacturer would make up with some inert material. The farmer by home mixing, saves this extra freight and handling.

Numerous formulas have been published for the various crops to be grown that differ considerably, with different authors. In the following formulas the potash will be found higher than is often given, as on most Florida soils this is the ingredient that is most deficient, and a liberal application will generally give a good return.

In the selection of material, one should bear in mind certain facts that have been well established. Thus, the muriate of potash is not a suitable form, in general, for edible root crops or for fruit and tobacco, but for cotton, grass, etc., it may be the cheapest and best. Citrus fruits do not do well with organic nitrogen, but this form, for a larger portion of the nitrogen at east, is beneficial to most garden crops. Another point to be

borne in mind is the availability of the materials, and whether it is desired that the plant shall take them up and make use of them at once, or whether they shall slowly become available through the growing season. Those materials that are soluble in water are, as rule, more immediately available than insoluble substances. Many substances as raw ground bone, gradually undergo changes in the soil by which their plant food is changed from an insoluble to a soluble and available form. The effect of such material is therefore noticeable for some time, it may be for years.

In recommending the use of the more concentrated fertilizing materials it must be borne in mind that they may easily be applied in such a way that the effect is lost or even that they may do a positive injury. Thus, nitrate of soda is one of the most available sources of nitrogen and at the same time one of the most liable to leach away before the plant can use it if applied too liberally at one time. During a protracted dry season the fertilizing elements cannot go into solution and are thus unavailable, unless the nature of the soil is such that there is naturally sufficient amount and movement of the soil water.

For home-mixing, as a rule, the concentrated materials and agricultural chemicals are the most economical and easiest to mix. To get the best results they should be finely ground and the mixture well incorporated. This is not difficult to accomplish if the materials are first passed through a seive, all lumps crushed, spread out in layers on a tight floor and then thoroughly shoveled together. The cost of such mixing should not be over \$1.00 a ton, at most. Another advantage is that they may be mixed at about the time they are to be used, thus preventing the gradual loss of plant food that often takes place when a mixed fertilizer is stored for any length of time.

Owing to the climatic conditions in this State, on which account live stock is shut up in barns and stables to a very limited extent, either in winter or summer, the farmer is largely deprived of the supply of barnyard manure that forms such a valuable source of fertilizing material with his more northern neighbor, particularly as a source of nitrogen and as coarse material to improve the physical character of the soil. The Florida farmer can, however, supply this to a certain extent by plowing

under green crops, especially leguminous plants as cowpeas and velvet beans.

RAW MATERIALS FOR MIXING.

A knowledge of the properties, action and characteristics of the various sources of plant food is essential, and a brief discussion of these follows:

Nitrate of Soda.—This is one of the most available and cheapest sources of nitrogen and is suitable for almost any crop. All forms of nitrogenous fertilizers except the nitrates must undergo chemical changes in the soil, called "nitrification," which is brought about by bacteria, before the plant can take it up. In nitrate of soda, however, we have what might be likened to a "predigested food" and the plant can take it up directly. Consequently it can and should be applied when needed and not in larger quantities than the plant can make use of. It comes on the market as a crystalline product of quite constant composition, averaging from 15 to 16 per cent. nitrogen. In calculating a formula that is to contain it 15.5 per cent. can be used. Like most all soda salts it is hygroscopic, or has the property of absorbing moisture from the air in damp weather, consequently it should be stored in as dry a place as possible if not used at once. It should not be used alone except in small amounts as a top dressing through the growing season. If used as a source of nitrogen in a fertilizer mixture, to be applied at the time of seeding, it is well to leave the larger part of it out, on account of its ready solubility, applying it as a top dressing subsequently in successive small applications through the growing season, by which means liberal returns will be received, especially on light sandy soils. It does not act so favorably on heavy marsh lands.

Sulphate of Ammonia.—This is a by-product in the manufacture of illuminating gas by the dry distillation of coal. It comes on the market as a crystalline salt, averaging from 20 to 21 per cent. of nitrogen. It is a most excellent source of nitrogen for all purposes, as it readily undergoes nitrification under favorable conditions. It may be used as the source of all or a part of the nitrogen and may often be mixed to advantage with nitrate of soda. The nitrogen in this material has a trade value of 17½ cents.

Nitrate of Potash.—This combines, in a very available form, both nitrogen and potash. It averages 10 to 13 per cent. nitrogen and 41 to 43 per cent. potash. It can be bought for about \$80.00 per ton and if it comes on the market in sufficient amount it should prove one of the most valuable fertilizing materials at our command. Samples sent to the Station lately are strongly impregnated with tobacco liquor, indicating its probable source. This should do no particular harm to the crop and adds an insecticidal property to the material.

Dried Blood, from slaughter houses, is another valuable source of nitrogen. Although not quite so quickly available as the forms already mentioned, it soon becomes so. Being an organic form, it should not be used on citrus trees except to a limited extent. A very excellent plan is to combine the three forms of nitrogen in one formula. Thus, one-fourth may be supplied as nitrate of soda, one-fourth as sulphate of ammonia and one-half as dried blood, thus insuring immediate and continued available nitrogen. This may be supplemented by one or two light top-dressings of nitrate of soda through the growing season. This plan probably offers the best possible way in which to supply the nitrogen needed for a crop.

Cotton Seed Meal is a valuable source of nitrogen for many crops, averaging about 7 per cent. but it is slower and more prolonged in its action than the materials already mentioned. It contains, in addition, a small amount of phosphoric acid and potash. For market garden crops, where a quick and strong growth is required, it is not so profitable as the more available forms mentioned, but for field crops that require the season to mature, it is often of more value and cheaper. The same applies to other similar forms, as castor pomace, tankage, fish and meat scrap, etc.

As a source of **Phosphoric Acid** in home-mixed fertilizers, probably either acid phosphate, dissolved bone black, ground raw or steamed bone or slag would be chosen. The point to be regarded in the selection of material is the availability of the phosphoric acid. Both acid phosphate and dissolved bone black are excellent materials, but the objection is often raised that they contain too much free acid. This is sometimes the case, especially when freshly made, and care should be taken that the material is not too fresh. As they are both made practically by

the same process, they are both open to this same objection, but if properly prepared the free acid should not be present in sufficient amounts to do damage. On an average, the acid phosphate can be figured at about 14 per cent. and the dissolved bone black at 18 per cent. available phosphoric acid.

The phosphoric acid in ground raw bone (20 to 25 per cent.) and in steamed bone (25 per cent.) is less available, but quite readily becomes so in the soil, if finely ground, as it usually is. As with nitrogen, one would choose these slower acting sources for field crops and orchards that require a season's growth, and the more available forms, in part at least, for garden and truck crops.

Basic Slag, also called Thomas slag, odorless phosphate, etc., is a valuable source of phosphoric acid, especially on soils inclined to be acid, on which it often gives better results than many of the other forms. It is a by-product from certain processes in iron smelting, by which phosphorus is removed. It comes on the market as a very finely ground powder which is also rich in lime. This excess of lime tends to correct the acidity of the soil and also favors nitrification. Although the phosphoric acid is in a more or less insoluble form, on account of its fine state of sub-division it quite rapidly becomes available to the plant. It would not be chosen for very quick action, but for orchards and the slower growing crops it is to be recommended as one of the cheapest sources of phosphoric acid. Recent experiments on pineapples by the Station have demonstrated its value for this crop.

Guano is another excellent material to use for phosphoric acid and also carries with it some nitrogen and potash, but it is well to supplement it with these two latter ingredients to make it more evenly balanced. A sample recently analyzed at the Station gave:

Nitrogen.....	2.80 per cent.
Potash.....	3.36 per cent.
Phosphoric Acid.....	27.81 per cent.

Different lots vary considerably in composition and value and it should therefore be bought on analysis only. It has been on the market for many years and has given most excellent results.

As sources of **Potash** we have the German Stassfurt salts, the high and low grade sulphate, muriate, carbonate of potash-magnesia, kainit, also nitrate of potash mentioned above under nitrogen, and as less concentrated forms, wood ashes, tobacco stems, etc.

Wood Ashes, while they are a most excellent source of potash, vary so largely in composition and are so bulky that it is better to rely on the more concentrated potash salts. Incidentally, however, more or less potash can often be supplied by home sources, such as palmetto ashes, which are exceptionally rich, samples analyzed at the Station running as high as 35 per cent. or more of potash.

The potash salts containing chlorides, as kainit and muriate of potash should not be applied to fruit and vegetables as a rule but are excellent for field crops and are less expensive than the other forms.

High Grade Sulphate of Potash averages about 50 per cent. of actual potash (K_2O) and can be safely used for any crop, although it is a little more expensive than some of the other forms. For tobacco, edible root crops and citrus trees especially it is the best potash salt to use.

The **Low Grade Sulphate** contains about 27 per cent. potash and is to be recommended on soils that are inclined to be acid, from the fact that it also contains magnesia, which tends to neutralize the acidity.

The **Muriate** is the cheapest source of potash. It contains about 50 per cent. actual potash and nearly as much, chlorine which makes it objectionable for certain crops, especially tobacco, oranges and potatoes. When used for other crops it is generally advisable to apply lime in connection with it.

Kainit is a crude product from the Stassfurt deposits with only about one-fourth the actual potash of the muriate and also contains chlorine. It has been used to a considerable extent and with good results on cotton, especially on light soils.

VEGETABLES

Fertilizer for General Use in the Garden.

The kitchen garden is the best place to apply the house wastes and home sources of fertilizer which are available to a

greater or less amount on every farm. Barnyard manure is one of the most efficient means at the disposal of the farmer to permanently improve his soil. Probably no other fertilizer possesses this power to so great a degree. The surface of the farm yard with all the droppings in the sheds should be carefully preserved and applied to the garden. When this is done, the amount of nitrogen in the fertilizer formulas can often be cut down one-half or more.

In recommending a formula for general use in the garden, we have omitted muriate of potash and would advise either the high or the low grade sulphate, generally the former. For Florida soils, a very good general formula for the garden, for all vegetables, is one containing

Nitrogen.....	4 per cent.
Potash.....	8 per cent.
Phosphoric acid.....	7 per cent.

Applied at the rate of 1000 to 1500 pounds per acre.

Now let us see just how we would go to work to mix the equivalent of 1000 pounds of the above formula, at home. We will select, as the best combination for this, the following sources of plant food:

Nitrate of soda for one-fourth of the nitrogen,
 Sulphate of ammonia for one-fourth of the nitrogen,
 Dried blood for one-half of the nitrogen,
 High grade sulphate of potash as the source of potash, and
 Acid phosphate for the phosphoric acid.

We will give in full here the method of calculation to find out just how much of each of the above must be used, and the same method may then be applied to other cases. The formula calls for 4 per cent. of nitrogen or 4 pounds in 100. We are figuring for 1000 pounds, therefore we shall require 40 pounds of nitrogen and of this, 10 pounds is to be supplied each by nitrate of soda and sulphate of ammonia and 20 pounds by dried blood. Nitrate of soda averages about 15 per cent. nitrogen, therefore,

$$15 : 100 :: 10 : 66\frac{2}{3}$$

thus $66\frac{2}{3}$ pounds nitrate of soda will give us the 10 pounds of nitrogen.

We require likewise 10 pounds nitrogen from sulphate of ammonia which averages about 20 per cent. nitrogen, therefore,

$$20 : 100 :: 10 : 50$$

thus 50 pounds sulphate of ammonia will give us 10 pounds of nitrogen.

From dried blood, which averages 12 per cent. nitrogen, we want 20 pounds, thus:

$$12 : 100 :: 20 : 166\frac{2}{3}$$

giving $166\frac{2}{3}$ pounds as the amount of dried blood necessary.

For potash, we want 8 per cent. or 80 pounds in 1000. The high grade sulphate averages 50 per cent. actual potash, therefore,

$$50 : 100 :: 80 : 160$$

thus we require 160 pounds of the high grade sulphate of potash.

For the phosphoric acid, we require 7 per cent. or 70 pounds in 1000. Acid phosphate averages 14 per cent., therefore,

$$14 : 100 :: 70 : 500$$

giving 500 pounds of acid phosphate necessary.

Thus, to get our mixture for one acre, equivalent to a fertilizer of the formula given above, we weigh out and mix:

60 pounds nitrate of soda,
50 pounds sulphate of ammonia,
166 pounds dried blood,
160 pounds high grade sulphate of potash,
500 pounds acid phosphate.

942

The difference between the 942 pounds and 1000 pounds is what the fertilizer manufacturer would put in as filler and what the farmer saves on freight. As to the cost of the above mixture, we will take the average market prices of the ingredients to be:

Nitrate of soda.....at	\$55 per ton,	66 pounds would cost	\$1.82
Sulphate of ammonia...at	71 per ton,	50 pounds would cost	1.78
Dried blood .....at	55 per ton,	166 pounds would cost	4.57
H. G. Sulphate potash at	52 per ton,	160 pounds would cost	4.16
Acid phosphate .....at	15 per ton,	500 pounds would cost	3.75

\$16.08

exclusive of the freight and the slight cost of mixing.

The price could be lowered by substituting cheaper and less available material but the real question the farmer should ask himself is not "how cheaply can I fertilize my land" but "how much fertilizer can I put on with profit." The above mixture will answer for all garden crops and if the other conditions, as rainfall, etc., are favorable and proper cultivation is given, will

give good returns for the money invested. Unless the soil is very rich, the amounts given above may profitably be increased one-half at least, and as stated above, may be supplemented with any of the home sources of fertilizer that can be obtained. By carrying out the same method as above, one material may be substituted for another as desired, as dissolved bone black for the acid phosphate, or the low grade for high grade sulphate of potash.

MODIFICATIONS OF THE GENERAL FORMULA FOR SPECIAL CROPS.

Asparagus.—This appears to be grown to a limited extent only, in Florida, but there is no reason that it should not do well and prove a very profitable crop. In order to be remunerative it requires good culture and heavy feeding and it is probably from lack of these that failures have occurred in this State. As the plant remains in the ground year after year, the fertilization is somewhat different than for an annual. Salt has a beneficial effect on this plant and for this reason kainit, which contains from 30 to 33 per cent. of salt, is one of the best forms in which to apply the potash. Heavy dressings of stable or barnyard manure are recommended but the crop can be grown with profit with chemical fertilizers. For a bearing crop, the following materials and amounts may be applied per acre in the spring:

400 pounds dried blood,
600 pounds kainit,
1000 pounds acid phosphate.

When the cutting is about half through it is well to apply 50 to 100 pounds per acre of nitrate of soda along the rows (taking care to apply it when the plants are dry, and not in contact with them, otherwise the shoots will be injured), and repeat when the cutting is finished, in order to give a vigorous growth while maturing, for the next season's crop.

Beans.—The general formula, applied at the rate of 1000 to 1500 pounds per acre should give good results, the easily available nitrates insuring a good start, the blood becoming available later as the plant matures.

Beets.—These, to be of the best quality, should be grown rapidly. Most soils of the State are rather sandy and light for beets,

yet they can be raised in many localities. If attempted to any extent, on a light soil, it would be of decided benefit to plow under some green crop the year before. The general formula may be used to advantage, but as the crop should mature quickly, the nitrogen may be applied wholly as nitrate of soda and sulphate of ammonia, and one or two additional applications of nitrate of soda, 100 pounds to the acre, at each application, during the growth of the plant may be made.

Cabbage.—This plant does best on a rich heavy loam and requires heavy feeding, especially of nitrogen and phosphoric acid, to get the best results. If grown for the market, it will be well to increase the nitrogen in the general formula. For this purpose, cotton seed meal or some of the similar cheaper sources of nitrogen may be substituted in part, to advantage. An application of the following formula and amounts to the acre should insure a good crop, other conditions being favorable:

800 pounds cotton seed meal,
50 pounds nitrate of soda,
500 pounds acid phosphate,
250 pounds high grade sulphate of potash.

Cantaloupes.—The nitrogen for this crop may be supplied largely as cotton seed meal. A very good formula, per acre, is:

Nitrate of soda.....200 pounds
Cotton seed meal.....800 pounds
Acid phosphate.....400 pounds
High grade sulphate of potash.....200 pounds

After the plants are well up a small handful of nitrate of soda around each hill will aid in a quick, vigorous growth.

Cauliflower.—This plant is a gross feeder and good fertilization is essential for a successful crop. The following mixture and amounts per acre may be used to advantage:

Nitrate of soda.....250 pounds
Cotton seed meal.....400 pounds
Acid phosphate.....600 pounds
High grade sulphate of potash.....400 pounds

Celery.—The success of this crop depends largely on the presence of abundant plant food, especially nitrogen, in an available form. The growth must be rapid and uninterrupted in order to get a good crisp stand. Heavy dressings of stable manure are generally recommended, but when this cannot be obtained, reliance must be placed on commercial fertilizers. The general formula

may be used at the rate of 1500 pounds or more per acre. Numerous experiments have shown that nitrate of soda is especially valuable to this plant, and in addition to the above two applications may be made of this, 200 pounds to the acre each, with profit.

Corn.—Sweet corn as a garden crop may receive about 1000 pounds to the acre of the general formula.

Cucumbers.—For a long growing and shipping season, as well as for a rapid growth when starting, which is advisable in order to give the plants a good start ahead of their insect enemies, more nitrogen should be applied than the general formula calls for. Many experiments show that nitrate of soda is one of the best forms for this. An excellent plan is to apply 1000 pounds of the general formula per acre, followed by two applications through the season, of 200 pounds each per acre of nitrate of soda.

Lettuce does well in this State and is a valuable shipping crop in many localities. While barnyard manure is generally recommended, it can be grown profitably with chemical fertilizers only, but these must be applied liberally. Muriate of potash can be substituted for the high grade sulphate in the general formula without injury to this crop, but the nitrogen is best supplied as nitrate of soda to insure a quick growth, applied in two or three applications. If the land is suitable, a deep, black, sandy loam being best, the fertilizer may be applied at the rate of 1500 to 2000 pounds per acre.

Onions.—For this crop cotton seed meal may be substituted for a large part of the nitrogen, and the potash, of which considerable is needed, may be supplied as kainit, thus lowering the expense. The following mixture may be used per acre :

Cotton seed meal.....	800 pounds
Kainit.....	1000 pounds
Acid phosphate.....	600 pounds

Peas.—These require very much the same fertilization as beans. Cotton seed meal may be used, in connection with some nitrate for the nitrogen.

Peppers.—These are planted to a comparatively small extent as a market crop. The general formula will give good results.

Potatoes.—Irish potatoes, as a market crop, are becoming of considerable importance in certain parts of the State. They

can be grown wholly on commercial fertilizers and when so grown are less liable to scab as when grown with stable manure. A liberal fertilization is profitable. The general formula may be applied at the rate of 1500 pounds per acre, supplemented with 100 pounds nitrate of soda as a top dressing after the plants are well up, especially for early potatoes. Potash salts containing chlorides should not be used.

Sweet potatoes require less nitrogen than many crops. If too much is supplied it makes a vigorous growth of vines but the roots are not as good quality. 500 to 800 pounds cotton seed meal may be used for the nitrogen, applied before the crop is planted, or one may use 250 pounds of cotton seed meal with 75 pounds nitrate of soda or 100 pounds of dried blood. Sulphate of potash should be used as a source of potash as the quality is injured by the chlorine in the muriate or kainit as it is in Irish potatoes. 100 pounds to the acre may be used, with 300 pounds of acid phosphate. When grown for stock more fertilizer may be used to secure a larger crop but the quality is apt to be somewhat poorer.

Squash.—1000 to 1500 pounds per acre of the general formula may be used, applying one-half of the nitrate as a second application after the plants are up.

Tomatoes.—The general formula may be used on this crop at the rate of 800 to 1000 pounds per acre. Muriate of potash may be used in place of the sulphate. A very good application is:

Nitrate of soda.....	250 pounds
Dissolved bone black.....	350 pounds
Muriate of potash	175 pounds

applying the nitrate in two or three applications.

Watermelons.—The best preparation for this crop is to plow under a crop of cowpeas or velvet beans. The nitrogen is needed mostly in the earlier stages of growth, the shipping quality of the melons being injured by over-dosing with this element when the fruit is setting. The supply of potash should be liberal and it is best in the form of sulphate. The general formula, therefore, may be altered somewhat as follows, if the green crop is plowed under:

Nitrate of soda.....	200 pounds
Acid phosphate.....	400 pounds
High grade sulphate of potash.....	160 pounds

GENERAL FORMULA FOR FIELD CROPS.

Field crops are grown either for manufacturing purposes, as cotton; for cattle feeds, as corn and hay; as fertilizing crops to be plowed under, as cowpeas and velvet beans, and for human use and consumption, as tobacco, rice and sugar cane. With the exception of tobacco and cane, they do not require the more expensive forms of plant food. As a general formula, the following will answer most purposes:

Nitrogen.....	2 to 3 per cent.
Phosphoric acid...	8 to 9 per cent.
Potash.....	3 to 4 per cent.

The nitrogen may be supplied as cotton seed meal or dried blood with perhaps a small amount of nitrate of soda. For the phosphoric acid we may use acid phosphate and for the potash, either the muriate or kainit (except for tobacco and cane). 800 to 1000 pounds per acre of the above formula may be applied to advantage, made up as follows:

Cotton seed meal.....	300 pounds
Acid phosphate.....	450 pounds
Muriate of potash.....	50 pounds

The muriate may be replaced by kainit by substituting for each pound of the former, four pounds of the latter.

Cassava.—May receive the following per acre:

Acid phosphate.....	250 pounds
Cotton seed meal.....	150 pounds
Muriate of potash.....	150 pounds

Corn.—Experiments made at this Station (see Report for 1901) showed that an application, per acre, consisting of

Acid phosphate.....	200 pounds
Nitrate of soda.....	75 pounds
Cotton seed meal.....	125 pounds
Muriate of potash.....	100 pounds

was made with profit. The cost of this is only about \$6.50 per acre. The trial plots in this experiment followed cotton as is the common practice. Half of the above application gave good results, giving as large a crop as the full application, but as a rule the full amount can probably be used to advantage.

For **Broom Corn** the general formula may be used at the rate of 500 to 600 pounds per acre.

Cotton.—The general formula at the rate given above serves excellently for cotton. A portion of the nitrogen as

nitrate of soda will insure a good start of the plants. After three years' trial, the Georgia Experiment Station (bulletin 39) found that the following mixture, per acre, gave the best and most economic results:

Acid phosphate.....	468 pounds
Muriate of potash.....	36 pounds
Cotton seed meal.....	286 pounds

with the remark that possibly a little more cotton seed meal and a little less acid phosphate would have given still better results.

Hay.—Grass is not grown very extensively to cut and cure as hay in many parts of the State, but in a few counties it forms quite an item. The general formula may be used at the rate of 500 pounds or more per acre.

Millet.—The same remarks apply to this crop as to hay and grass.

Oats.—Experiments on the fertilization of this crop have shown, in many cases, a corresponding increase in yield, but often not sufficient to pay for the extra cost of the fertilizer. If the land is poor, however, an application should be made in order to get a good stand. 300 to 500 pounds of the general formula may be used.

Peanuts.—The peanut does not seem to do as well with a too liberal supply of nitrogen as it is apt to make the nuts coarse with a thick rough shell. Phosphoric acid and potash, however, should be supplied in fairly liberal amounts and an application of lime seems to be very beneficial. The general formula may be used at the rate of 600 to 1000 pounds per acre. The acid phosphate in this formula probably supplies sufficient lime, but if the soil is very deficient in this element, 100 or 200 pounds per acre may be added.

Rice.—This crop is grown either under water or on dry land with irrigation. If the former method is used, the fertilizer, if insoluble, must be applied in the spring before the land is flooded, in order that nitrification may go on, which is not the case under water. If irrigation is practiced and the drainage through the soil is not too rapid, fertilization may be successfully accomplished by dissolving soluble sources of plant food in the irrigation water, for which purpose the German potash salts, high grade acid phosphate and nitrate of soda or sulphate of ammonia may be used. A certain amount of plant food is supplied by the

irrigation water itself. If the land is fertilized dry, 600 to 700 pounds of cotton seed meal may be applied in January, well worked into the soil, followed, after irrigation has commenced, with 200 to 300 pounds acid phosphate and 100 to 150 pounds muriate of potash.

Sugar Cane.—For the successful growth of this crop, with a high per cent. of sugar, abundant nitrogen must be supplied with a fair amount of phosphoric acid and potash. The nitrogen may be supplied as acid phosphate, dissolved bone black, cotton seed meal or slag, the two latter being slower in their action but more lasting. A portion of the nitrogen is profitably supplied as nitrate of soda as a second application after the plants are started. The fertilizer may be either applied broadcast and worked into the soil before planting or it may be placed under the plant cane and covered with soil at the time of planting. A good deal of the success of the crop depends on thorough cultivation. The following proportions may be used per acre:

Cotton seed meal.....	400 to 500 pounds
Nitrate of soda.....	50 to 100 pounds
Acid Phosphate.....	300 to 400 pounds
Kainit	100 to 150 pounds

Tobacco.—The quality and profit from this crop is affected more than any other by conditions of soil, climate, cultivation, curing and fertilizing. The crop requires and repays for very liberal fertilization, if care is used in the selection of material. Home-mixing is especially to be recommended for this crop, as oftentimes a small per cent. of an injurious ingredient, as chlorine, may injure the crop many dollars' worth. The special tobacco fertilizers put up and sold by dealers vary to a considerable extent in their composition. Stable manure, to a limited extent, may be used on tobacco and it also does well following a crop of peanuts. In this case the amount of nitrogen may be cut down.

The following mixture may be used, per acre:

Cotton seed meal.....	300 pounds
Nitrate of soda.....	150 pounds
Acid phosphate.....	300 pounds
High grade sulphate of potash.....	200 pounds

The nitrate of soda may be applied as a second application after the crop is started. If at any time during the growth the

leaves begin to take on a yellowish cast, another dressing of 100 to 200 pounds of nitrate of soda should be made.

Velvet Beans.—This has proved a valuable crop to be used either as forage or to plow under preparatory to other crops. In fertilizing, but very little nitrogen need be applied. The following mixture is recommended per acre:

Nitrate of soda	50 pounds
or Cotton seed meal.....	100 pounds
Acid phosphate.....	200 pounds
Sulphate of potash.....	100 pounds

GENERAL FORMULA FOR FRUITS.

The fertilization of orchards, groves and small fruits that remain in the ground for many years, can be carried out on a little different line than for an annual plant which is to complete its growth and be removed in one season. The tree bears its crop of fruit, which is removed, and also adds to its growth in leaves, wood and roots. Many trees drop their leaves in the fall thus returning a small amount of the plant food to the soil. The requirements of an orchard tree are therefore not only what is lost to it in the crop, but sufficient to insure a good growth. It may oftentimes be advantageous to supply a portion of the food in a less soluble and less expensive form than is called for in a quickly maturing crop and supplementing this at the time the fruit is forming by some quick acting, available plant food. Whatever the crop may be, it pays here, as well as in the garden, to fertilize liberally. Trees, after they get well established, will generally bear fruit even if neglected, but the quality rapidly deteriorates and it is never at its best unless sufficient plant food is supplied. Many fruits, especially those of the citrus family, respond very quickly to fertilization and are very much influenced by the kind of fertilizer applied. In general, an abundant supply of potash seems to improve the delicacy and the sugar content. Chlorine appears to act injuriously to the quality of some fruits and it is best not to use compounds containing it in the orchard or grove. For a general application, applicable to most

fruits, berries and nuts, the following formula will be found useful per acre:

Nitrate of soda.....	300 pounds
Acid phosphate.....	500 pounds
Sulphate of potash.....	200 pounds

The nitrate can be divided into two or three applications. This mixture contains no nitrogen from organic sources and may be safely used on citrus fruits as well as others. On some fruits, especially those not belonging to the citrus family, a portion of the nitrogen may be supplied as dried blood, also on pecans and other nuts. It is not advisable to remove crops from bearing orchards and groves, but a portion of the nitrogen may be supplied by plowing under a leguminous crop as the velvet bean or cowpea.

Avocado Pear.—This has not been experimented upon in regard to its fertilization to any extent. The general formula given above would be a safe application.

Banana.—This plant requires a rich soil to reach perfection. The potash in the general formula may be profitably increased to 300 pounds or more and, as the plant requires some chlorine, it may be supplied in the form of muriate, otherwise an occasional small application of salt would be beneficial. The fertilizer may be divided and made in two applications during the year. The following formula answers the fertilizer requirements:

Nitrate of soda.....	200 pounds
Dried blood.....	200 pounds
Acid phosphate.....	500 pounds
Muriate of potash.....	400 pounds

Cocoanuts.—Very little data is available for determining the best formula for this crop. When grown on the seacoast, as it usually is, heavy dressings of seaweed would undoubtedly be very beneficial. The more slowly available and lasting materials may be used, as raw ground bone, cotton seed meal, etc.

Fig.—The fig requires abundant lime and if the soil is deficient in this ingredient, it should receive an occasional dressing. This, with the general formula, should insure a good crop.

Grapes.—The profitable fertilization of the vine is an important question in grape-growing sections. It has been found that it is not advantageous to supply much nitrogen during the latter part of the season, as it tends to lessen the number of fruit

buds the next season. The following mixture may be applied in the spring:

Nitrate of soda.....	100 pounds
Acid phosphate.....	200 pounds
High grade sulphate of potash.....	100 pounds

On very poor soils, these quantities may be doubled. In July, it should be followed by another application of 100 pounds nitrate of soda.

Grapefruit requires practically the same treatment as the orange and other citrus fruits. It is a large bearer and a gross feeder. For a bearing tree one may apply:

Nitrate of soda.....	10 pounds
Acid phosphate.....	4 pounds
Sulphate of potash	10 pounds

This can be divided into two or three applications for the year, in February, June and October.

Guava.—Few experiments have been made on fertilizing this fruit. The general formula may be used at the rate of 600 to 1000 pounds per acre.

Japanese Persimmons.—These should receive about 5 pounds to a tree of the following proportions:

Nitrogen.....	3 per cent.
Phosphoric acid.....	6 per cent.
Potash.....	10 per cent.

It does not appear to make much difference as to the choice of materials for this plant. The nitrogen may be supplied largely by a crop of beggar weed or cowpea.

Lemons, Limes, Kumquats and Loquats should receive practically the same as the orange.

Orange.—This fruit, on account of its importance in the State has received considerable attention and from many years' experience certain facts have become well established. There is yet, however, considerable difference of opinion as to the best materials to use. The orange responds more quickly, perhaps, than any other fruit to fertilization and likewise more quickly indicates improper fertilization by the quality of the fruit. The potash salts containing chlorides are no longer used and the nitrogen supply, except to a limited extent and where the effects can be closely watched, is not supplied from organic sources. Opinion is divided, also, as to whether two or three applications are best,

most growers adopting the former. Taking the average, so to speak, of the experience of some of the larger and experienced growers, the following proportion seems to be the one giving the best results:

Nitrogen 4 per cent. as nitrate of soda and sulphate of ammonia,
Phosphoric acid 6 per cent. as acid phosphate or dissolved bone black,
Potash 12 per cent. as high grade sulphate of potash.

Taking the above formula as a basis, the following mixture per acre may be used, or it may be applied at the rate of 20 pounds or more to each bearing tree, according to size:

Sulphate of ammonia.....	200 pounds
Nitrate of soda.....	150 pounds
Dissolved bone black.....	500 pounds
(or acid phosphate.....)	640 pounds)
High grade sulphate of potash.....	360 pounds

This may be divided into three applications, thus: one-fourth in June, one-fourth in October and one-half in February. There seems to be no injury in plowing under a cover crop for a portion of the nitrogen supply and some successful growers introduce a small amount of dried blood.

Peaches.—Peach trees should be liberally fertilized early in the growing season. Young trees require abundant nitrogen and potash, while for older, bearing trees, nitrogen and phosphoric acid seem to be especially called for. A good application is as follows, to each tree according to size:

Nitrate of soda.....	1 to 5 pounds
Acid phosphate	4 to 10 pounds
Sulphate of potash.....	3 to 6 pounds

Pears.—The fertilizing requirements of the pear are much the same as for the peach. With insufficient plant food, especially if the season is dry, there is much danger of the fruit dropping off. To prevent this the tree should make a vigorous growth while the fruit is setting and for this purpose, available plant food should be supplied abundantly. The general formula may be used at the rate of 1000 pounds per acre or more, followed by a later application of 100 to 200 pounds of nitrate of soda per acre.

Pecans.—Although this tree, when once properly started, would probably continue to bear nuts without further attention or care, there is no doubt that fertilization is necessary to preserve

the quality and to get the best and most profitable returns. No systematic experiments have been carried on in regard to fertilizing the pecan. When the trees are young, if other crops are grown between the rows, they should be well fertilized in order not to remove the plant food in the soil necessary to the trees. Cotton seed meal, raw ground bone and materials of this nature may be applied around young trees, with small amounts of muriate of potash. As the trees get into bearing the potash should be increased and small applications of nitrate of soda could be made to advantage.

Pineapples.—Experiments on the fertilization of this plant have been carried on by this Station for four years and are still in progress. Until they have been conducted further, definite results, as to the best formula to be used, cannot be given. They are, however, giving some indications that are of value. The formula here recommended is taken from the experience of growers. The following formula may be used at the rate of 2000 to 3000 pounds per acre in two applications, February and and July :

Nitrogen.....	3 per cent as dried blood or cotton seed meal
Phosphoric acid.....	7 per cent. as fine ground bone, dissolved bone black or slag
Potash.....	7 per cent as high or low grade sulphate of potash

some growers make an additional application in the fall or early winter.

Strawberries.—This crop should be liberally fertilized. The following application, per acre, may be used:

Nitrate of soda.....	200 pounds
Dried blood.....	300 pounds
Dissolved bone.....	450 pounds
Acid phosphate.....	350 pounds
Sulphate of potash (high grade).....	600 pounds

The dried blood, phosphate and potash may be applied immediately after the harvest, the nitrate of soda as soon as the new growth begins in the spring.

**AVERAGE COMPOSITION OF THE MATERIALS
RECOMMENDED IN PER CENTS.**

	Nitrogen=	Phosphoric acid	Potash
Nitrate of soda.....	15	...	...
Sulphate of ammonia.....	20	...	...
Dried blood.....	12½	...	...
Cotton seed meal.....	6½	1½ to 2	2 to 3
Nitrate of potash.....	10	...	40
Raw ground bone.....	3	20	...
Steamed bone.....	2	25	...
Acid phosphate.....	...	15	...
Dissolved bone black.....	...	18	...
Guano.....	3 to 10	10 to 25	2 to 4
Thomas slag.....	...	18	...
High grade sulphate of potash...	...	...	50
Low grade sulphate of potash...	...	...	28
Kainit.....	...	...	12½
Muriate of potash.....	...	...	50
Tobacco stems.....	2	1	6

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22 Fertilizers.....	pp. 48	58 Pomelos.....	pp. 43
24 Annual Report.....	" 32	59 Cauliflower.....	" 20
25 Leeches and Leeching.....	" 17	60 Velvet Beans.....	" 24
26 Big Head.....	" 19	61 Two Peach Scales.....	" 32
27 Pineapple.....	" 14	62 Peen-to Peach Group.....	" 22
28 Liver Fluke—Southern Cattle Fever.....	" 15	63 Packing Citrus Fruits.....	Folio
30 The Culture of Tobacco.....	" 28	64 Texas Fever and Salt Sick.....	pp. 31
32 Cotton and Its Cultivation.....	" 4	65 The Kumquats.....	" 14
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- 4 The White Fly.
- 6 Nursery Inspection (part I).
- 7 Nursery Inspection (part II).
- 8 Care of Irish Potatoes Harvested in the Spring and Held for Fall Planting.
- 9 Sore Head.
- 10 Plants Affected by Root Knot.
- 11 Vinegar.
- 12 Seed Beds and Their Management
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- 35 Food Adulteration—Butter.
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Florida
Agricultural Experiment Station
Agricultural Department.

A Preliminary Report on Growing Irish Potatoes.

CHAS. M. CONNER.

The Bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Florida

St. Augustine, Fla.
THE RECORD COMPANY
1906



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A PRELIMINARY REPORT ON GROWING IRISH POTATOES.

CHAS. M. CONNER.

Irish potatoes are grown in Florida for the early market and are all dug and shipped as new potatoes. Few if any growers allow their crop to mature. Earliness is quite important, hence every precaution is taken to make the crop ready for the market as soon as possible after the growing season opens. Some localities are better suited for the growing of this crop than others, owing to the protection from frost by the presence of water and growing timber.

The soil, in the section where the bulk of the crop is grown, is what is called "flat woods" but is underlaid with clay instead of hard pan. The surface soil is made up largely of sand and humus and is usually acid. Drainage is the most serious problem on account of the level nature of the country and the nearness of the water table to the surface.

The potatoes are planted on a very high bed—from 18 to 20 inches—to keep the seed out of the water and allow the soil to warm rapidly. The ends of the rows are opened into a ditch which carries the water off during heavy rains.

All stumps and roots are removed before planting in order that machinery may be used. The ground is broken deeply with a turn plow during the winter and harrowed with a cutaway just before planting time. A disc cultivator is used for throwing up the beds. These cultivators have the outside disc larger than the inside one which is a great help in throwing up the beds. The first trip with the cultivator throws up a broad flat bed about 12 inches high. The fertilizers are then applied and worked in with a light harrow, then another trip with the cultivator increases the height to 18 inches. The rows are three feet and one-half to three feet nine inches apart.

Large quantities of fertilizers are used in order to **force the** crop and gain as many days on the market as possible. Where

these large quantities of fertilizers are used it is necessary that the ground be nearly saturated with water to keep the plants from burning up. Irrigation is practiced with good results where artesian water can be had. Irrigation is not always necessary but it frequently happens that the season is dry toward the end, thus checking the growth of the crop.

That the crop is called upon to make rapid growth would seem to call for the fertilizer to be all in soluble form; yet the open nature of the soil, the heavy rainfall during the early part of the growing season and the presence of an excess of water, in the absence of the heavy rainfall, on account of the nearness of the water table to the surface of the soil makes it rather difficult to hold the fertilizer in the soil. This is shown by the two plats in the rate test which received no fertilizer.

The average fertilizer contains 4 per cent of ammonia, 6 per cent of phosphoric acid and 8 per cent of potash. The ammonia is from an organic or inorganic source according to the judgment of the grower. It is claimed by some that the organic forms give best results during cold wet seasons and that the inorganic forms give best results during rather dry seasons. Most of the phosphoric acid is derived from acid phosphate and potash almost exclusively from sulphate of potash. Some buy the raw materials and do their own mixing while others buy ready mixed goods or have them mixed according to their own formula.

A special distributor is used in applying the fertilizer. The fertilizer is distributed on the top of the broad bed as described above at the rate of one ton per acre. The residual fertilizer is taken up by a crop of corn, cow peas or other crops planted after the potato crop is harvested. Sometimes a second crop of potatoes is planted but this is not general.

The Irish potato has few insect enemies in this State. The potato beetle is not known here. Diseases did not give much trouble until within the last few years. This is probably due to planting the crop on the same land year after year. Careful seed selection and a short rotation would serve to keep the diseases in check.

All the seed used in this section is northern grown or second crop seed grown in the latitude of Virginia. Florida grown seed does not give profitable returns. Great care is taken in selecting and cutting the seed because good seed is essential to a perfect

stand. Where such large quantities of fertilizers are used it is very important that all the ground be occupied with the crop. Grass grows rapidly where there are skips and interferes with harvesting, besides the loss of the fertilizer put in the ground and not used. The seed potatoes are spread out in a thin layer in a barn or under a shed and exposed to subdued light for a time before planting. This allows them to green slightly and the small sprouts to start. If cut at the proper time and handled properly these sprouts need not be knocked off in planting. This method of handling enables the cutter to select sound seed. The pieces are cut to a uniform size with one or two eyes to the piece. All cutting is done by hand which makes it very expensive. Some machine cutters have been used but the stand is not so good where they are used. Some planters estimate that hand cut seed will give ten per cent better returns.

Planting begins about the middle of January and continues until about the middle of February. Most of the planting is done with a two-horse planter such as the Robbins. The Robbins is so constructed that a man sits at the feed and regulates the dropping. With a careful man no skips should be found.

Cultivation is practically all done with a disc cultivator. Some go over the field with a weeder first and follow with the cultivator about the time the plants are coming through and cover up the young plants as a protection against a probable frost. Just enough cultivation is given to keep down the grass and weeds until the tops begin to spread after which time the crop is laid by.

Digging is commenced as soon as the tubers are about two-thirds grown. This work is all done by hand on account of the tender skin being easily broken by rough handling. The potatoes are sorted as picked: one set of men pick up the first quality called No. 1 and other set pick up the next size called No. 2. This method insures uniformity in grading. The culls are left on the ground or are picked up later for feed or for seed for second crop.

EXPERIMENTS DURING THE SEASON OF 1905.

During the season of 1905 a series of experiments were conducted in the potato growing district to find if possible:

- 1st. The best source of ammonia.
- 2d. The best source of phosphoric acid.

- 3d. The best quantity of ammonia.
- 4th. The best quantity of phosphoric acid.
- 5th. The best quantity of potash.
- 6th. The best quantity of a complete fertilizer per acre.

A uniform piece of tile-drained land was selected that had been in potatoes for two years before. This ground was laid off in plats 1-40 acre in size and containing three rows, three and one-half feet wide. The hills were 12 inches apart. The plats were arranged in three tiers with check plats running through the three tiers. There were fifteen plats in each tier with a check plat between the fifth and sixth and tenth and eleventh, making seventeen in all. No space was left between the plats as the ridges were so high that the influence of the fertilizer could not extend from one row to the other. All check plats were fertilized alike. All fertilizers were applied at the rate of one ton per acre, unless otherwise noted.

The ground was prepared by first breaking with a turn plow, then cutting with a cutaway harrow. The beds were then thrown up with a disc cultivator. These beds are first made about 12 inches high and flat on top. The fertilizers were applied by hand and worked in with a light harrow, then the beds thrown up about 6 inches higher; this puts the fertilizer about where the seed potato will be put by the planter. The beds are allowed to stand for ten days after putting in the fertilizers. This precaution is found necessary where such large quantities are used.

The planting was done on February 5th with a planter. It was found after trial that the planter was as accurate as hand planting.

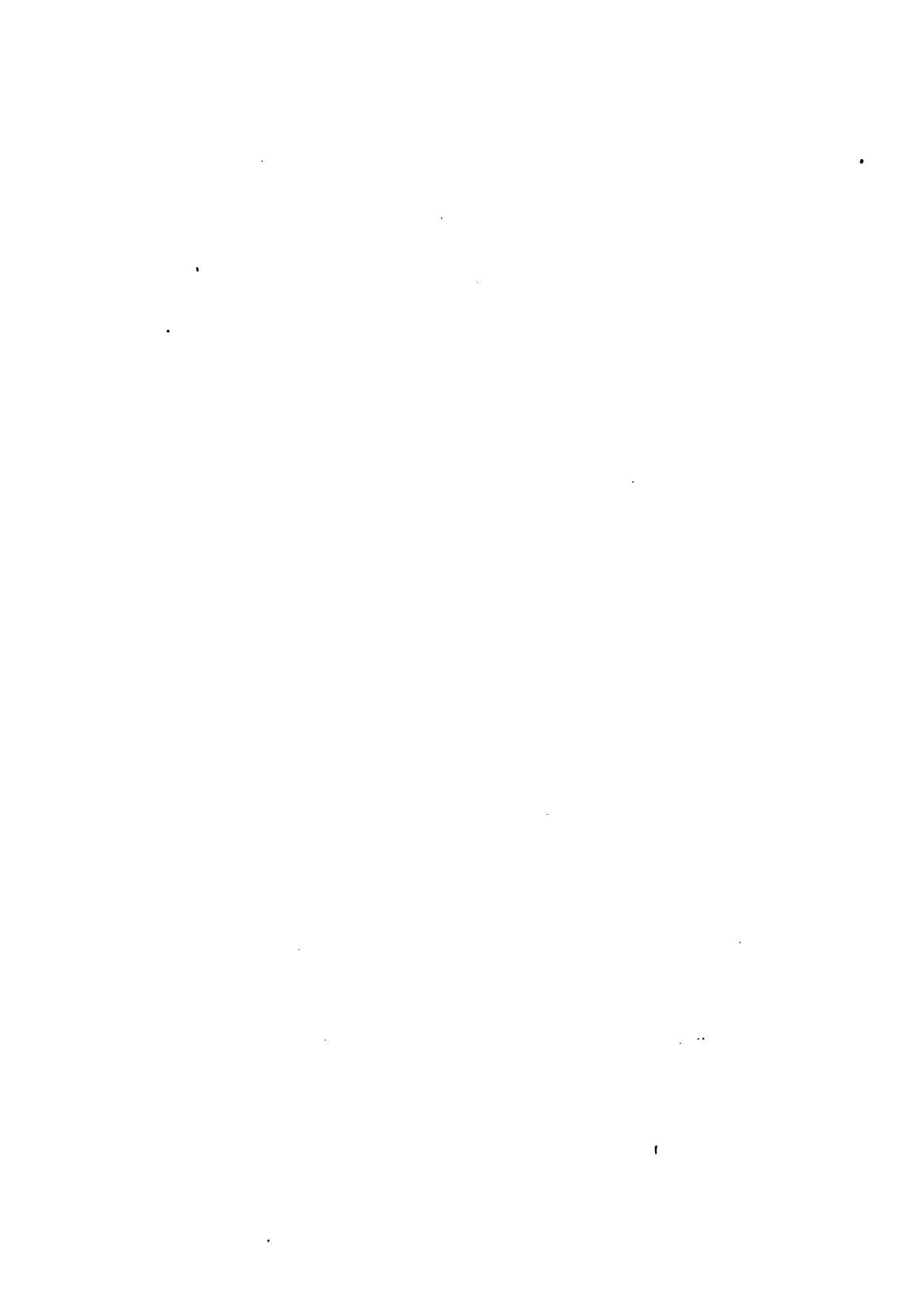
The cultivation was the same as that for the regular crop, being just enough to keep down weeds and keep the dirt up on the ridges.

The stand was almost perfect, there being only one or two per cent missing hills in some of the rows. There was no material difference in the appearance of the different plats of the fertilizer test except where small quantities of fertilizers were used in which case the vines did not appear so vigorous. No marked difference was noted where large and small quantities of ammonia were used.

On May the 5th and 6th the crop was dug. Each row was

sorted and weighed as dug. The same man did the sorting for all the plats in order to have the grading as uniform as possible.

While results for one season do not prove anything it is thought best to put this partial report in the hands of the growers in the absence of anything better. The experiments with Irish potatoes as reported from other States do not apply to Florida conditions. The reader is left to draw his own conclusion from the figures presented herewith. A report will be published in this form each year until the final report is made, when conclusions will be drawn and recommendations made.



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TEST OF DIFFERENT QUANTITIES OF AMMONIA, PHOSPHORIC ACID AND POTASH.

Since the crop must make its growth in a short time it is desirable to know what influence an increase or decrease over the normal amount, of ammonia, phosphoric acid and potash, would have on the rapidity of growth. It was supposed that this increase would be measured by the increased yield, as the crop is dug when two-thirds grown. The phosphoric acid and potash in the cotton seed meal and castor pomace was taken into account in making up these fertilizers. Fertilizers were applied at the rate of one ton per acre. The following table shows the source of ammonia, phosphoric acid and potash, per cent in one ton and yield per acre from same.

TABLE III.

Test of Different Quantities of Ammonia Per Acre.

No. of Plot	Kind of Fertilizer	YIELD PER ACRE				
	Per Cent.	No. 1. Bus. Per Acre	No. 2. Bus. Per Acre	Total Marketable, Bus. Per Acre	Culls, Bus. Per Acre	Total Yield, Bus. Per Acre
11	Ammonia from Sulphate of Ammonia 1.0 }	145	50	195	20	215
	Ammonia from Nitrate of Soda..... 2.5 }					
	Phosphoric Acid from Acid Phosphate..... 6.0					
	Potash from Sulphate of Potash..... 8.0					
12	Ammonia from Sulphate of Ammonia 1.0 }	137	62	199	18	217
	Ammonia from Nitrate of Soda..... 3.0 }					
	Phosphoric Acid from Acid Phosphate..... 6.0					
	Potash from Sulphate of Potash..... 8.0					
13	Ammonia from Sulphate of Ammonia 1.5 }	154	41	195	11	206
	Ammonia from Nitrate of Soda..... 3.0 }					
	Phosphoric Acid from Acid Phosphate..... 6.0					
	Potash from Sulphate of Potash..... 8.0					
14	Ammonia from Sulphate of Ammonia 1.5 }	140	31	171	10	181
	Ammonia from Nitrate of Soda..... 3.5 }					
	Phosphoric Acid from Acid Phosphate..... 6.0					
	Potash from Sulphate of Potash..... 8.0					
15	Ammonia from Sulphate of Ammonia 1.0 }	154	44	198	12	210
	Ammonia from Nitrate of Soda..... 2.5 }					
	Ammonia from Blood and Bone (H.G.) 1.0 }					
	Phosphoric Acid from Blood and Bone 0.7 }					
	Phosphoric Acid from Acid Phosphate 5.3 }					
	Potash from Sulphate of Potash..... 8.0	150	49	199	18	217
	*Check					

*This Check Plot belongs above No. 11. but is placed here for convenience.

TABLE III.—Continued.
Test of Different Quantities of Ammonia Per Acre.

No. of Plot	Kind of Fertilizer	YIELD PER ACRE				
		No. 1, Bus. Per Acre	No. 2, Bus. Per Acre	Total Marketable, Bus. Per Acre	Culls, Bus. Per Acre	Total Yield, Bus. Per Acre
Per Cent.						
16	Ammonia from Cotton Seed Meal.....2.0	133	39	172	25	197
	Ammonia from Blood and Bone.....2.5					
	Phosphoric Acid from Cot'n S'd Meal 0.3					
	Phosphoric Acid from Blood and Bone 1.7					
	Phosphoric Acid from Acid Phosphate 4.0					
	Potash from Cotton Seed Meal.....0.5					
Potash from Sulphate of Potash.....7.5	8.0					
17	Ammonia from Cotton Seed Meal.....1.6	144	49	193	24	217
	Ammonia from Castor Pomace.....1.4					
	Phosphoric Acid from Cot'n S'd Meal 0.3					
	Phosphoric Acid from Castor Pomace 0.2					
	Phosphoric Acid from Acid Phosphate 5.5					
	Potash from Cotton Seed Meal.....0.4					
Potash from Castor Pomace.....0.2	8.0					
Potash from Sulphate of Potash.....7.4	8.0					
18	Ammonia from Cotton Seed Meal.....2.6	174	37	211	21	232
	Ammonia from Castor Pomace.....1.4					
	Phosphoric Acid from Cot'n S'd Meal 0.4					
	Phosphoric Acid from Castor Pomace 0.2					
	Phosphoric Acid from Acid Phosphate 5.4					
	Potash from Cotton Seed Meal.....0.6					
Potash from Castor Pomace.....0.2	8.0					
Potash from Sulphate of Potash.....7.2	8.0					
19	Ammonia from Cotton Seed Meal.....3.0	160	40	200	24	224
	Ammonia from Castor Pomace.....2.0					
	Phosphoric Acid from Cot'n S'd Meal 0.5					
	Phosphoric Acid from Castor Pomace 0.3					
	Phosphoric Acid from Acid Phosphate 5.2					
	Potash from Cotton Seed Meal.....0.7					
Potash from Castor Pomace.....0.3	8.0					
Potash from Sulphate of Potash.....7.0	8.0					
Check		145	41	186	27	213

TABLE IV.

Test of Different Quantities of Phosphoric Acid Per Acre.

No. of Plot	Kind of Fertilizer Per Cent.	YIELD PER ACRE				
		No. 1. Bus. Per Acre	No. 2. Bus. Per Acre	Total Marketable, Bus. Per Acre	Culls. Bus. Per Acre	Total Yield, Bus. Per Acre
20	Ammonia from Cotton Seed Meal.....2.6	148	67	215	40	255
	Ammonia from Castor Pomace.....1.4					
	Phosphoric Acid from Cot'n S'd Meal 0.4					
	Phosphoric Acid from Castor Pomace.. 0.2					
	Phosphoric Acid from Acid Phosphate 4.2					
	Potash from Cotton Seed Meal.....0.6					
	Potash from Castor Pomace.....0.2					
*18	Potash from Sulphate of Potash.....7.2	174	37	211	21	232
	Ammonia from Cotton Seed Meal.....2.6					
	Ammonia from Castor Pomace.....1.4					
	Phosphoric Acid from Cot'n S'd Meal 0.4					
	Phosphoric Acid from Castor Pomace.. 0.2					
	Phosphoric Acid from Acid Phosphate 5.4					
	Potash from Cotton Seed Meal.....0.6					
21	Potash from Castor Pomace.....0.2	182	56	238	45	283
	Potash from Sulphate of Potash.....7.2					
	Check					
	Ammonia from Cotton Seed Meal.....2.6					
	Ammonia from Castor Pomace.....1.4					
	Phosphoric Acid from Cot'n S'd Meal 0.4					
	Phosphoric Acid from Castor Pomace.. 0.2					
22	Phosphoric Acid from Acid Phosphate 6.4	156	51	207	44	251
	Potash from Cotton Seed Meal.....0.6					
	Potash from Castor Pomace.....0.2					
	Potash from Sulphate of Potash.....7.2					
	Ammonia from Sulphate of Ammonia.. 1.0					
	Ammonia from Nitrate of Soda..... 3.0					
	Phosphoric Acid from Acid Phosphate.....5					
23	Potash from Sulphate of Potash.....8	130	51	181	16	197
	Ammonia from Sulphate of Ammonia.. 1.0					
	Ammonia from Nitrate of Soda..... 3.0					
	Phosphoric Acid from Acid Phosphate.....6					
	Potash from Sulphate of Potash.....8					
	Ammonia from Sulphate of Ammonia.. 1.0					
	Ammonia from Nitrate of Soda..... 3.0					
24	Phosphoric Acid from Acid Phosphate.....7	142	45	187	24	211
	Potash from Sulphate of Potash.....8					

*Placed here for comparison. Fertilizer has the same composition as Check Plot.

TABLE V.
Test of Different Quantities of Potash.

No. of Plat	Kind of Fertilizer	Per Cent.	YIELD PER ACRE				
			No. 1. Bus. Per Acre	No. 2. Bus. Per Acre	Total Marketable, Bus. Per Acre	Culls, Bus. Per Acre	Total Yield, Bus. Per Acre
	Check		145	41	186	27	213
25	Ammonia from Cotton Seed Meal..... 2.6	4	149	37	186	35	221
	Ammonia from Castor Pomace..... 1.4						
	Phosphoric Acid from Cot'n S'd Meal 0.4						
	Phosphoric Acid from Castor Pomace 0.2	6					
	Phosphoric Acid from Acid Phosphate 5.4						
	Potash from Cotton Seed Meal..... 0.6						
	Potash from Castor Pomace..... 0.2	7					
Potash from Sulphate of Potash..... 6.2							
*18	Ammonia from Cotton Seed Meal..... 2.6	4	174	37	211	21	232
	Ammonia from Castor Pomace..... 1.4						
	Phosphoric Acid from Cot'n S'd Meal 0.4						
	Phosphoric Acid from Castor Pomace 0.2	6					
	Phosphoric Acid from Acid Phosphate 5.4						
	Potash from Cotton Seed Meal..... 0.6						
	Potash from Castor Pomace..... 0.2	8					
Potash from Sulphate of Potash..... 7.2							
26	Ammonia from Cotton Seed Meal..... 2.6	4	157	43	200	30	230
	Ammonia from Castor Pomace..... 1.4						
	Phosphoric Acid from Cot'n S'd Meal 0.4						
	Phosphoric Acid from Castor Pomace 0.2	6					
	Phosphoric Acid from Acid Phosphate 5.4						
	Potash from Cotton Seed Meal..... 0.6						
	Potash from Castor Pomace..... 0.2	9					
Potash from Sulphate of Potash..... 8.2							
27	Ammonia from Cotton Seed Meal..... 2.6	4	167	29	196	28	224
	Ammonia from Castor Pomace..... 1.4						
	Phosphoric Acid from Cot'n S'd Meal 0.4						
	Phosphoric Acid from Castor Pomace 0.2	6					
	Phosphoric Acid from Acid Phosphate 5.4						
	Potash from Cotton Seed Meal..... 0.6						
	Potash from Castor Pomace..... 0.2	10					
Potash from Sulphate of Potash..... 9.2							

*Placed here for comparison.

TABLE V.—Continued.
Test of Different Quantities of Potash.

No. of Plat	Kind of Fertilizer	YIELD PER ACRE				
	Per Cent.	No. 1. Bus. Per Acre	No. 2. Bus. Per Acre	Total Marketable. Bus. Per Acre	Culls. Bus. Per Acre	Total Yield. Bus. Per Acre
28	Ammonia from Sulphate of Ammonia 1.0 } 4	167	47	214	12	226
	Ammonia from Nitrate of Soda..... 3.0 } 4					
	Phosphoric Acid from Acid Phosphate..... 6					
	Potash from Sulphate of Potash..... 7					
*23	Ammonia from Sulphate of Ammonia 1.0 } 4	130	51	181	16	197
	Ammonia from Nitrate of Soda..... 3.0 } 4					
	Phosphoric Acid from Acid Phosphate..... 6					
	Potash from Sulphate of Potash..... 8					
29	Ammonia from Sulphate of Ammonia 1.0 } 4	192	29	221	16	237
	Ammonia from Nitrate of Soda..... 3.0 } 4					
	Phosphoric Acid from Acid Phosphate..... 6					
	Potash from Sulphate of Potash..... 9					
30	Ammonia from Sulphate of Ammonia 1.0 } 4	166	36	202	8	210
	Ammonia from Nitrate of Soda..... 3.0 } 4					
	Phosphoric Acid from Acid Phosphate..... 6					
	Potash from Sulphate of Potash..... 10					
	Check	162	48	210	23	233

*Placed here for comparison.

TEST OF PERUVIAN GUANO.

Two bags of Genuine Peruvian Guano was furnished by Edmond Mortimer & Co. for this test. One bag high in phosphoric acid and one high in ammonia. They were mixed with phosphoric acid and sulphate of potash and applied at the rate of one ton per acre as shown in the following table:

TABLE VI.
Test of Peruvian Guano.

No. of Plat	Kind of Fertilizer	YIELD PER ACRE				
	Per Cent.	No. 1, Bus. Per Acre	No. 2, Bus. Per Acre	Total Marketable, Bus. Per Acre	Culls, Bus. Per Acre	Total Yield, Bus. Per Acre
31	*Ammonia from Peruvian Guano..... 2.0	122	49	171	27	198
	Ammonia from Cotton Seed Meal..... 2.0					
	Phosphoric Acid from Peruvian Guano 6					
	Potash from Peruvian Guano..... 2.2					
	Potash from Sulphate of Potash..... 5.8					
32	Ammonia from mixture of equal parts of two Guanos..... 4	119	28	147	17	164
	Phosphoric Acid from same..... 6					
	Potash from the same..... 2.2					
	Potash from Sulphate of Potash..... 5.8					
33	†Ammonia from Peruvian Guano..... 4	161	28	189	15	204
	Phosph'c Acid from Peruvian Guano 3:0					
	Phosph'c Acid from Acid Phosphate 3.0					
	Potash from Peruvian Guano..... 1.0					
	Potash from Sulphate of Potash..... 7.0					
	Check	152	29	181	24	205

*Peruvian Guano high in Phosphoric Acid.

†Peruvian Guano high in Ammonia.

TEST OF DIFFERENT QUANTITIES OF NORMAL FERTILIZER.

This test was inaugurated to find the best quantity of fertilizer to use per acre. No attempt is made here to give a money value to the crop as the market fluctuates so.

The test was made in duplicate using two sources of ammonia as shown in the following tables:

TABLE VII.*Test of Different Quantities of Fertilizer per Acre.*

This fertilizer contained 4 per cent. of Ammonia, 6 per cent. of Phosphoric Acid and 8 per cent. of Potash. The Ammonia derived from Cotton Seed Meal and Castor Pomace, Phosphoric Acid from Acid Phosphate and Potash from Sulphate of Potash. (See Plat No. 18.)

No. of Plat	Rate Per Acre	YIELD PER ACRE				
		No. 1, Bus. Per Acre	No. 2, Bus. Per Acre	Total Marketable, Bus. Per Acre	Culls, Bus. Per Acre	Total Yield, Bus. Per Acre
34	1400	161	30	191	16	207
35	1600	177	30	207	16	223
36	1800	150	27	177	19	196
37	2000	160	30	190	17	207
38	2200	170	44	214	20	234
39	*	33	45	78	33	111
40	*	20	23	43	33	76

*No Fertilizer.

TABLE VIII.*Test of Different Quantities of Fertilizers per Acre.*

The fertilizer used in this test contained 4 per cent. Ammonia, 6 per cent. Phosphoric Acid and 8 per cent. of Potash. Ammonia derived from Sulphate of Ammonia and Nitrate of Soda, Phosphoric Acid from Acid Phosphate and Potash from Sulphate of Potash. (See Plat No. 23.)

No. of Plat	Rate Per Acre	YIELD PER ACRE				
		No. 1, Bus. Per Acre	No. 2, Bus. Per Acre	Total Marketable, Bus. Per Acre	Culls, Bus. Per Acre	Total Yield, Bus. Per Acre
41	1400	155	32	187	17	204
42	1600	155	32	187	29	216
43	1800	156	53	209	28	237
44	2000	180	46	225	32	258
45	2200	188	38	226	33	259

TEST OF VARIETIES.

A variety test of Irish potatoes was also made during the season of 1905 at the same place where the fertilizer test was made. Only early varieties were used as late varieties are of little use. An attempt was made to get Virginia second crop seed of the northern varieties in order to make a test of the relative merits of the two kinds of seed, but only a few varieties of such seed were obtained. Only red or pink varieties are used for growing for the early market, the white ones do not sell well nor do they stand shipping as well as the red or pink varieties.

Rose No. 4 is about the only variety used among the commercial growers. This variety is oblong, rather flat with pink shallow eyes. It is known by several names and as a number of seed houses have been making a specialty of growing seed for the Florida planters there are some differences in the car lots of seed as shipped in. These differences are due to the different methods followed in growing and selecting seed. The place where they are grown may have some influence also.

The list as given below is in the order that they were planted in the field. Near the bottom of the list will be found a variety called "Rose 4, Home-grown." This seed was grown during the previous Fall from small potatoes left from the Spring crop. Potatoes so grown are slow to sprout and make slow growth. The test of stem and blossom ends as shown at the bottom of the list did not show that one was any better than the other.

A normal fertilizer was used at the rate of one ton per acre. The preparation of the land, plats and method of cultivation were the same as described for the fertilizer test.

TABLE IX.
Test of Varieties of Irish Potatoes.

VARIETY	YIELD PER ACRE			DESCRIPTION OF VARIETY		
	No. 1, Bushels Per Acre	No. 2, Bushels Per Acre	Total Marketable, Bushels Per Acre	Shape—R, Round; O, Oblong; L, Long	Eyes—D, Deep; S, Shallow	Color
*Wood's Earliest.....	125	28	153	R	D	Pink
†Early Rose.....	107	24	131	Ob	S	Brown, pink eyes
*Early Rose (second crop)...	130	35	165	Ob	S	Pink
†Spaulding's Rose 4.....	87	38	125	R	D	Red
*Early White Rose.....	115	57	172	L	S	White
*Wood's Earliest (Maine seed).....	125	31	156	R	D	Pink
*Thoroughbred.....	33	11	44	Ob	S	White, pink eyes
*Early Ohio.....	94	33	127	Ob	S	White, pink at one end
*Junior Pride.....	116	45	161	R	D	White
*Early Harvest.....	96	38	134	R	S	White
*Crown Jewel.....	131	34	165	Ob	S	Slightly pink
*Puritan (second crop).....	122	24	146	R	S	White
*Early Sunlight.....	90	34	124	R	D	White
*White Bliss (second crop)...	127	36	163	R	D	Pink
*Red Dakota.....	84	33	117	R	D	Red
†Beauty of Hebron.....	104	36	140	Ob	S	White
*Bliss' Triumph.....	113	25	138	R	D	Red
*White Bliss (Maine seed)...	106	23	129	R	S	Pink
‡Rose 4 (Massachusetts seed)	118	42	160	.....	.....	.....
‡Rose 4 (Virginia second crop).....	161	18	179	.....	.....	.....
‡Rose 4 (home grown).....	69	20	89	.....	.....	.....
Rose 4 (blossom ends).....	166	49	215	.....	.....	.....
Rose 4 (stem ends).....	194	31	225	.....	.....	.....

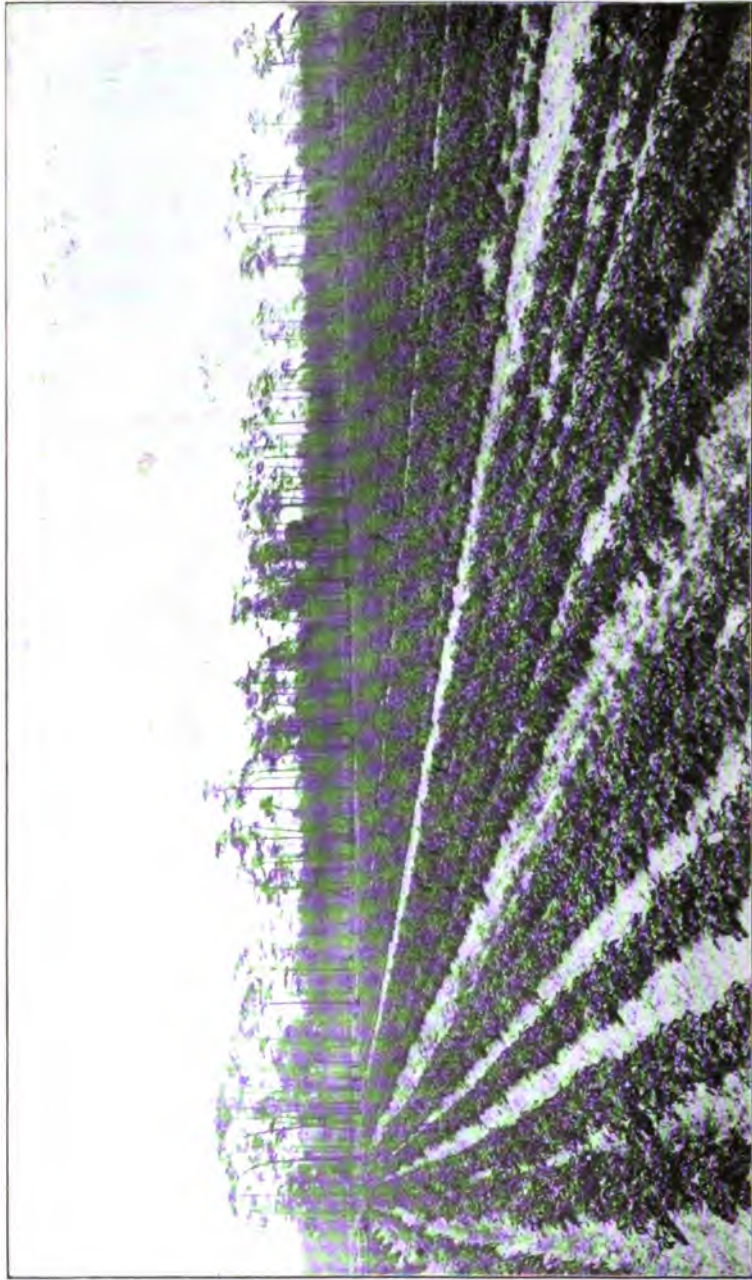
* Seed from T. Wood & Son.

† Seed from McLaurin, Jacksonville.

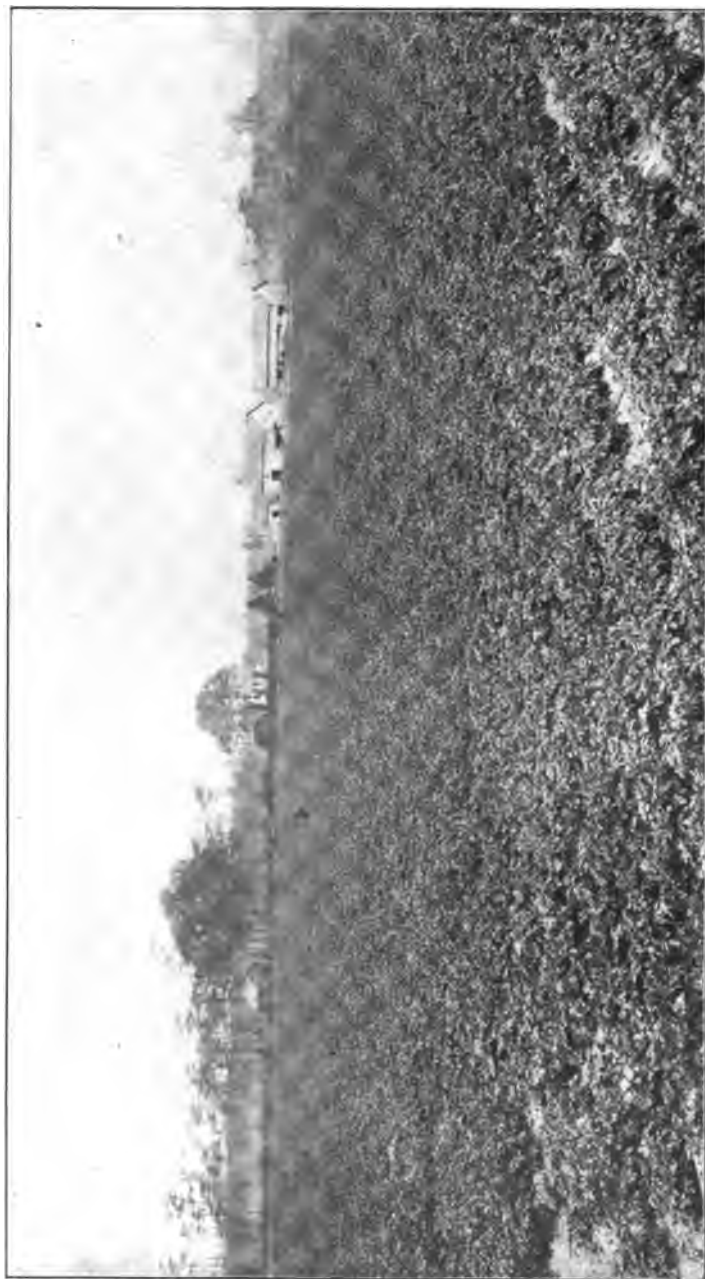
‡ Seed from Mr. Leonard, Hastings.



PLANTING



**SHOWING METHOD OF PLOWING LAND IN BEDS. WATER FURROW SHOWS
NEAR EACH LOWER CORNER OF CUT**



LOOKING ACROSS THE ROWS



DIGGING AND SORTING IRISH POTATOES

230,679
Feb

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JAN 18 1909

BULLETIN No. 83.

FEBRUARY, 1906.

· FLORIDA ·
AGRICULTURAL EXPERIMENT STATION.

Pineapple Culture III. Fertilizer Experiments.



By H. K. MILLER and A. W. BLAIR

The bulletins of this Station will be sent free to any address in Florida upon application to the Director of the Experiment Station, Lake City, Fla.

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PINEAPPLE CULTURE III.

Fertilizer Experiments.

H. K. MILLER and A. W. BLAIR.

INTRODUCTION.

It would perhaps be difficult to say just when commercial fertilizers were first used for pineapples, but it is safe to say that they were not very extensively used before about 1890 or 1891; and in this connection it is interesting to note that the pineapple industry in Florida has had its growth largely since that time.

There is little doubt that Capt. Richards, one of the pioneers of the pineapple industry on the East Coast, used commercial fertilizers as early as some time in the '80's, though we have no record of any comparative tests so early as this.

Dr. L. C. Washburn, reporting from the Fort Myers sub-station in a bulletin¹ issued July 1st, 1891, says: "I would set the rows three feet apart, north and south, opened out with two furrows. I would put well rotted muck, marl, stable manure or sea grass freely in the trenches, and spade it up and mix well with the soil, pulled in from each side." And further along in the same report he says: "If planted with suckers, hoe in the fertilizers between the rows in six months, but if planted with slips, hoe in fertilizers between the rows in one year, so the feeder roots can reach it." However he does not tell us what kind of fertilizer he would use.

EARLY EXPERIMENTAL WORK.

In 1892 Dr. Washburn began some comparative fertilizer tests at the Ft. Myers sub-station, report of which is made in bulletin No. 27 Fla. Expt. Station. These were not very successful, however, and appear to have been discontinued after the summer of 1894. In discussing the subject of fertilizers Dr. Washburn says: "The pineapple is a voracious feeder. It requires heavy fertilizing; nitrogen, phosphoric acid and potash

¹ Bulletin No. 14, Florida Experiment Station, July 1st, 1891.

are all required in generous amounts. Perhaps the following manures are the best sources from which to obtain these requirements: poultry manure, stable manure, guano, blood and bone, bone meal, cottonseed meal, acid phosphate, sulphate of potash and well rotted muck. If compost is used, it should be well rotted and ready for assimilation. Compost undergoing fermentation will destroy the feeder roots."

On some of his experiment plots Dr. Washburn used a compost made as follows:

Dark cottonseed meal.....	1,000 lbs.
Kainit.....	500 "
Acid phosphate	500 "
Blood and Bone.....	500 "
Cow Manure	2,000 "

On one of the plots receiving this compost at the rate of six tons per acre, more than half the plants were affected with "long leaf," which he attributes to fermentation of the compost. However, in the light of more recent experiments one would probably attribute some of the bad effects, at least, to the kainit and acid phosphate. Another plot which received this compost, at the rate of two tons per acre, taken from the top of the pile, and in addition, a top dressing of hen manure, is reported as a complete success. Still another, which received five tons per acre and was mulched with salt marsh grass, proved a failure. A plot fertilized with cottonseed meal one and one-half tons per acre, and kainit five hundred pounds per acre, is also reported as a failure. It is perhaps due Dr. Washburn to state that he expressed his disapproval of the above-mentioned compost for pineapples, and adds that it was not of his choosing.

Further comparative tests were not made until the winter of 1897-8, when a rather extensive experiment was begun by Prof. P. H. Rolfs, then Biologist and Horticulturist to this Station, on the lands of Ballentine and Moore, at Jensen on the Indian River. The results of this experiment were published in bulletin No. 50² of the Station. The bulletin gives the general plan, details and results of the work, and conclusions which were drawn from the results. Different forms of phosphoric acid, nitrogen and potash were used alone and in combination. A study was made of the effect of fertilizers upon leaf area and upon

² Pineapple Fertilizers, P. H. Rolfs, Florida Station, Bulletin No. 50.

freeze resistance of the plants. A table of fruit picked from some of the plots in June 1899 is given. On the basis of the experiment the author suggests a plan for fertilizing pineapples in Florida and draws a number of conclusions, among which may be mentioned the following:

"The fertilizers used to furnish ammonia stand in the following order, beginning with the best: (1) blood and bone, (2) nitrate of soda, (3) cottonseed meal, (4) sulphate of ammonia."

"Potash salts stand in the following order: (1) potassium-magnesium carbonate, (2) low grade sulphate of potash, (3) high grade sulphate of potash, (4) muriate of potash, (5) kainit."

"Bone meal is very much better than acid phosphate."

"A fertilizer analyzing 4 per cent. ammonia, 6 per cent. potash and 1 per cent. phosphoric acid is nearer correct than the normal one taken as an arbitrary basis on which to begin work."

"There is a certain amount of ammonia, of potash and of phosphoric acid, which, if applied to the soil, proves of greatest benefit to the plants; any variation, either a decrease or an increase of any one or more of these fertilizers, will be disadvantageous."

"The amount of ammonia, of potash and of phosphoric acid which may be applied to the soil to produce the best results varies with the different sources from which it is obtained."

"There is a certain amount of ammonia, of potash and of phosphoric acid which produces the greatest freeze resistance in pineapple plants; any increase or decrease of any one or more of the ingredients produces a less freeze resistant plant."

"Freeze resistance varies with sources from which the ammonia and potash are obtained."

The experiment was discontinued after about 18 months.

Fertilizer experiments conducted in Queensland³ in 1899 indicated that pineapples were much benefitted by the application of a mixture of soluble nitrogenous and phosphatic materials, but contrary to the results obtained by the Fla. Station, up to that time, potash seemed to have little if any effect.

In Jamaica⁴ experiments were carried on in six different

³ Queensland Agricultural Journal, 4 (1899), No. 6 pp. 472-473.

⁴ Annual Report Department Public Gardens and Plantations and Board Agriculture (Jamaica), 1903, pp. 16-19.

localities, using from one to thirteen different fertilizer formulas in each case. In only one case was the addition of fertilizers to the soil found beneficial. In this case larger fruits of finer quality were obtained. An analysis of this soil indicated a low standard of fertility. The soil in the other cases appeared to be sufficiently fertile. In one of the experiments in which a test was made of the effect of fertilizers on "monstrous plants" the results indicate that neither slag, superphosphate, mixed phosphate or sulphate of potash had any effect in checking the formation of such fruits. The fertilizers used in the experiments were sulphate of ammonia almost exclusively for nitrogen, superphosphate and steamed bone for phosphoric acid and sulphate of potash for potash.

H. H. Cousins⁵ states that soil containing thirty times the amount of plant food present in the Florida sands has been used for pineapples, in some instances, with the result that the plants made phenomenal growth of foliage, but scarcely any fruit. Nine-tenths of the plants were monstrosities. The fruits consisted of reduplicated crowns, and in some cases a mass of axillary leaf shoots.

Notwithstanding the small amount of experimental work that has been done on the fertilizing of pineapples, much progress has been made along this line during recent years, and very satisfactory results are being obtained by many of the growers. However, there still remains much to be learned, and it was with the hope of adding something to the knowledge already existing on this subject, that the Experiment Station, in co-operation with Hardee Bros., of Jensen, began, in 1901, an extensive fertilizer experiment, the results of which, up to the present time, will be reported in this bulletin as intelligently as possible.

OBJECT.

The object of this experiment is to find out from what source or sources it is best to obtain fertilizing materials for pineapples; the proper quantity to use for the best results as regards quantity, quality, and shipping properties; best method of applying; ratio of phosphoric acid, nitrogen and potash; the effect of shading, and to determine any other conditions which will prove of advantage to the industry.

⁵ Journal Jamaica Agricultural Society 5 (1901), No. 10, pp. 403-405.

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SOIL	DEEP SUB-SOIL PER CENT
70	99.2660
62	00.0412
00	00.0062
49	00.0131
48	00.0110
75	00.3693
62	00.0194
--	00.0000
	1.3160
	1300
	050

Nitrogen 00.010

⁶ For a discussion of pineapple soils, see Pineapple
K. Miller and H. Harold Hume, Bulletin No. 68, Floric

The agreement entered into between the Station and Hardee Bros. was that the Station should plan and conduct the experiment, put up the shed, furnish the fertilizers mixed and bagged ready for the various plots, and have such fruit as might be required for analytical purposes. Hardee Bros. were to furnish the land, set out and cultivate the plants, apply the fertilizers under the direction of a representative of the Station, gather and keep count of the crop, and have such part of the crop as was not required by the Station for analytical purposes. It was mutually agreed that the experiment should run for at least five years.

DETAILED PLAN OF FERTILIZER APPLICATION.

Before deciding upon the ratio in which phosphoric acid, nitrogen and potash should be used in the fertilizers, analyses of the fruit and plant were made to determine the ratio in which these are present. While it is true that too much dependence cannot be placed in this method of determining the food requirements of plants and fruit, still it aids in estimating the amount of plant food removed by the crop, and knowing this, it is less difficult to determine the requirements. The results of these analyses will be found in Table II.

TABLE II.
Analysis of the Pineapple—Plant and Fruit.

Station No.	P ₂ O ₅ PER CENT	N PER CENT	K ₂ O PER CENT
<i>Analyses of Fruit (Fresh).</i>			
1285.....	.0753	.0640	.2565
1325.....	.0591	.0931	.2930
1330.....	.0446	.0910	.2630
<i>Analyses of Plant (Air Dried).</i>			
1286.....	.8545	.5330	1.3000
1326.....	.7975	.8300	1.3900

With the above analyses, and the practice of the more successful growers as a basis, it was determined that the ratio of the fertilizer constituents be as follows:

Phosphoric Acid.....	.80
Nitrogen	1.00
Potash.....	2.00

That is, these amounts in pounds were considered to be the normal annual requirements of 100 plants, as determined by analysis and experience. By reference to Diagram II it will be seen that plot No. 2 of Section A., for example, is given this normal or standard amount, while plot one has one-fourth less than the standard, plot three, one-fourth more than the standard, and plot four, one-half more than the standard or twice as much as plot one, the object of this being to determine the quantity of plant food that will give the best results, assuming that the ratio taken is the correct one. By a careful study of the diagram it will be seen that this plan has been followed with combinations of all the fertilizers that were considered most worthy of trial. (Ammonium sulphate, for example, was ruled out on the ground of former experience.) Bone meal, dried blood and high grade sulphate of potash were taken as the standard, or rather ideal materials. It should be noted that in reading from left to right on the diagram—with certain exceptions—the plots have identical amounts of the fertilizing elements, or plant food, the difference being in the sources from which they are derived. A few of the sections were introduced for special purposes and do not conform to this rule. For example, section F. is intended to show whether the addition of lime to the standard ingredients, bone, blood and high grade sulphate of potash, will prove beneficial; section C. being the same with the exception of the lime. In the same way section K. is designed to show whether the addition of lime to acid phosphate, blood, and sulphate of potash, will prove beneficial; section A. being the same with the exception of the lime. Section L. was designed to find out what is likely to prove the best ratio for phosphoric acid, nitrogen and potash. On sections R. and S. bone was used as the only source of nitrogen, thus very materially increasing the amount of phosphoric acid added. In section V. the normal amount is kept constant, while the number of applications is varied, the intention being to determine the number of applications that will give the best results. Section W. is designed to determine if it is worth while to vary the ratio during the different stages of growth. For example, on plot 89 the ratio for the first and second applications was phosphoric acid 3 per cent., nitrogen 6 per cent. and potash 12 per cent.; for the third and fourth applications the ratio was phosphoric acid 4 per cent..

nitrogen 4 per cent. and potash 12 per cent. and so on throughout the section. Section X. is the same as section C. with the exception that each plot in section X. received ten pounds additional bone meal at the beginning. The fertilizers were analyzed at the Station, carefully weighed out and mixed, and the proper amount for each plot put into a separate bag before being shipped to Jensen.

It should be explained that in the case of fertilizers containing more than one of the three essential ingredients, as cottonseed meal, castor pomace and bone meal, all of the ingredients were included in calculating the amount to be added. For example, where cottonseed meal was used as the source of nitrogen, the amount of phosphoric acid in the required amount of cottonseed meal was calculated, and this amount was taken into consideration when calculating the amount of bone or other substance supplying phosphoric acid. In the same way, when bone meal was used with some other substance supplying nitrogen, as for example, nitrate of soda, the nitrogen of the bone meal was taken into consideration when calculating the amount of nitrogen to be obtained from the nitrate of soda. Sections R. and S., however, are exceptions to this, inasmuch as they received the required amount of nitrogen in the form of bone meal, and thus necessarily received more than the required amount of phosphoric acid. Digram II. indicates the quantities of fertilizers applied to the various plots, the amount there given being the amount for one year, and except where otherwise indicated this was given in four applications, the first year, as follows:

First Application.....	October 18th, 1901
Second Application.....	March, 1902
Third Application.....	July, 1902
Fourth Application.....	November, 1902

In addition to this the plants were given a handful of cottonseed meal in the bud about three week after setting out. The fifth application was made in April, 1903, and the sixth after the summer crop of 1903 had been removed. After this time, only two applications a year were made—except perhaps in the case of a few special plots—one in February or March as the conditions seemed to require, and the other soon after the gathering of the summer crop. After the crop of 1903 had been

removed the plants appeared to be suffering for nitrogen and they were given an application of cottonseed meal, all plots being treated alike. Some other variations occurred which should be mentioned. On account of circumstances which could not be controlled, the regular summer application for 1904 was not made, and in order that the plants might not suffer, Hardee Bros. put on about 1300 pounds bone, blood, and high grade sulphate, analyzing 7 per cent. phosphoric acid, $6\frac{1}{2}$ per cent. nitrogen and $7\frac{1}{2}$ per cent. potash. Two hundred pounds of land plaster was also added. This application was made on the 25th of August, 1904.

CHANGES MADE IN 1905.

Beginning with the March application for 1905, some changes were made owing to the fact that in the case of certain plots all had been demonstrated that could be demonstrated and it was unnecessary to continue them under those conditions. Among these may be mentioned sections A. and B. where the plots received acid phosphate without lime; section N. on which acid phosphate and nitrate of soda were both used; section Q. on which nitrate of soda was used as the only source of nitrogen, and sections R. and S. on which bone was used as the only source of nitrogen. On sections A. and B. the acid phosphate was replaced by bone and slag respectively, with the idea of finding out if either of these materials would tend to counteract the injurious effects produced by the acid phosphate. It may be stated here that these injurious effects have been marked almost from the beginning. On these plots there has been a decided tendency to "spike" or "long leaf," and the plants have never had that healthy, vigorous appearance which has characterized many of the plots. On the other hand, section K. which received the same fertilizers and in the same amounts as section A., and lime at the rate of 750 pounds per acre in addition, has all the while been one of the most promising sections, and in general appearance and productiveness, ranks well up to the section that has been considered the best. Sections N. and Q. had been so badly injured and given such unsatisfactory results, the first as a result of using acid phosphate and nitrate of soda, and the second as a result of using nitrate of soda, that beginning with the spring

application for 1905 they were entirely dropped from the experiment. Here, too, the injurious effects were noted early in the experiment, and the plants have gone from bad to worse. A fact that has been especially noticeable in these two sections is, that as the fertilizers were increased, the injurious effects upon the plants seemed to be increased. There was a tendency to "spike" and the plants seemed lacking in vigor and healthy appearance.

The early records of section Q., however, indicate that it started off well, showing the usefulness of nitrate of soda for getting plants started to growing, but the later records show a gradual falling off as noted above. Nitrate of soda, too, seems to produce a fruit of green color which does not ship well, becoming soft and decaying rapidly, and there is also a tendency for the fruit to "plug" or break off too far up in the base of the pine, thus causing early decay. In the case of sections R. and S. where bone was used as the only source of nitrogen, it became evident that this combination would not be practicable as a pineapple fertilizer, since nirtogen obtained in this way is too expensive. The results obtained from section R. where muriate was used would also indicate that this combination is not adapted to pineapples, even though it should not prove too expensive. These two sections might have been discarded altogether, but for the fact that it was desired to see what would be the effect of furnishing nitrogen in the form of cottonseed meal for a time, without adding any further phosphoric acid. It was thought that this would give an opportunity to see how long the effects of the excess of phosphoric acid which had been added, could be observed. The applications of lime have not been made to sections F. and K. this year, the plots appearing not to need further lime at present.

NOTES KEPT ON THE PROGRESS OF THE EXPERIMENT.

Notes were taken on the growth, general progress and appearance of the plants at several different times during the past four years, and while it will not be advisable to incorporate all of these notes in a bulletin, still it is possible to give a brief general summary of the records. These records, taken in connection with the results from the crops, will form the basis of conclusions to be drawn and recommendations to be made.

PLATE XX.



Plot No. 8—Acid Phosphate, Dried Blood, Muriate.



Plot No. 12—Zone Meal, Dried Blood, High Grade Sulphate.

Sections A. and B. were treated alike except that A. received high grade sulphate and B. muriate. As already noted, both received acid phosphate, and as shown by the notes, there has been a tendency to "spike" and the plants have lacked that healthy appearance which a normal plant should have. This condition has been attributed to the acid phosphate, and when we compare these sections with others treated in the same way except as regards source of phosphoric acid, and also with section K. which received acid phosphate but in addition 750 pounds of lime to the acre, and when we further consider the general experience of many of the growers, we are forced to accept this as the explanation of the poor showing which these sections have made. Of the two sections A. has given better results than B. which emphasizes the superiority of the sulphate over the muriate.

Sections C. and D. were treated alike except in source of potash, C. receiving high grade sulphate and D. muriate. They have both made good progress and have been reported from time to time as "good" sections, the term "fair," however, having been applied to some of the plots of D. occasionally. In general appearance and for the most part in crop returns, C. has given the best results; again indicating the superiority of the sulphate over the muriate.

Sections E., F. and G. received bone and dried blood, and low grade sulphate, high grade sulphate and kainit respectively as the source of potash. Section E. has made good progress and has been reported as "good" and even sometimes as "excellent," and if we compare the number of fruits taken from this section with the number taken from other sections we also find that the results are good. Section F. received the same as section C. and in addition 750 pounds of lime per acre. It has made good progress and has been reported as "good," and sometimes as "very good," but if we judge by the fruit produced C. has given better results than F., which would indicate that lime is not required with these ingredients. The injurious effects of the kainit on section G. have been very apparent all the while. This is even more clearly emphasized by a study of the tables giving the results of the crops. It seems reasonable to attribute the injurious effects to the chlorides in the kainit, inasmuch as

muriate also does not seem to be a suitable form in which to apply potash.

Sections H., I. and J. received slag and dried blood, and muriate, high grade sulphate, and kainit respectively as the source of potash. They are all good sections and the plants have, during the greater part of the experiment, had a strong, healthy appearance, with little or no tendency to "spike." Section I., however, is and has been better than the other two, and has been reported from time to time as the best section in the entire plot. A careful study of the tables in Diagram III. will emphasize this fact. The number of pines obtained from this section has not always been the largest, but when total numbers, number of the larger sizes, and general progress are all taken into consideration, we are safe in saying that this has been the best section. It should be observed that this section received the standard formula, with the phosphoric acid supplied from slag (odorless slag phosphate, or Thomas slag) instead of bone. Other sections in the experiment received slag, but no others received both dried blood and high grade sulphate in addition. The section receiving muriate did better than the one receiving kainit but not so well as the one receiving high grade sulphate.

Section K. as mentioned under the head of special sections, was designed to determine whether lime would have a tendency to correct the injurious effects of acid phosphate. So far, the results decidedly indicate an affirmative answer. The plants have maintained a splendid condition and have given good results as compared with other sections, from the very beginning. At times it has been difficult to detect much difference between this section and section I., which has been regarded as the best. It is not an easy matter to say why the acid phosphate has an injurious effect upon pineapples, nor to say in what way the lime prevents or corrects this. The most satisfactory explanation we can offer is that ordinary acid phosphate contains sulphates of iron and aluminum, and it is really the presence of these astringent salts which causes the injury. This view seems the more correct when it is known that acid phosphate derived from bone black has no injurious effect on pineapple plants. The application of lime with the acid phosphate converts these injurious sulphates into harm-

PLATE XXI.



Plot No. 20—Bone Meal, Dried Blood, Low Grade Sulphate.



Plot No. 28—Bone Meal, Dried Blood, Kainit.

less insoluble oxides. It is perhaps well to caution against the use of dissolved bone black, in as much as in many cases, high grade acid phosphate, colored with charcoal, is on the market in imitation of the dissolved bone black. It is well for one not experienced in the chemistry of fertilizers to use no form of acid phosphate whatever for pineapples, but rely upon bone meal or slag. This explanation of the cause of the injurious effects of acid phosphate on pineapple plants is not given as a fact which has been fully demonstrated, but as what seems to be the most plausible explanation with the evidence that is before us.

Section L. was designed to find out what is likely to prove the best ratio for phosphoric acid, nitrogen, and potash, the four plots receiving the same kind of fertilizer, but in different ratios. The notes taken on this section from year to year show that it has been a good section and that the plots have been fairly uniform in size, though the third plot, No. 47, is recorded as being just a little better than the others, and it is of interest to note that the ratio of phosphoric acid, nitrogen and potash on this plot approaches very nearly the ratio adopted for the experiment, and further, as will be shown later, the amount per acre—3750 pounds—is the same as the amount that has given the best results in general.

Section M. is recorded as a good uniform section, and has given results that compare very favorably with the best.

Section N. as already noted has been discontinued on account of the injurious effects of the acid phosphate and nitrate of soda. It started off well but soon manifested a tendency to "spike," which tendency has been more or less apparent during the entire time.

Section O. has given good results, and the plants have been fairly uniform, with a healthy, vigorous appearance. A comparison between the results from this section and section M., which differs from it only in the source of phosphoric acid, M. receiving bone and O. slag, will show that O. has given practically the same results.

Section P. has given good results, though the injurious effects of the nitrate of soda have been noted to some extent. The fact that a part of the nitrogen was derived from the bone

meal tends to make these injurious effects less than where nitrate of soda is used as the only source of nitrogen.

Section Q. has also been discontinued for the reason just suggested, that is, that nitrate of soda when used in sufficient quantity to furnish all the nitrogen proves injurious both to the plants and to the shipping qualities of the fruit. This section started off well, indicating that the formula may be suitable for getting young plants started to growing. For notes on sections R. and S. see notes on page 420.

Section T. has been recorded as a good section, with healthy, vigorous plants. The results as shown by the crops compare favorably with some of the sections that have been classed among the best.

Section U. has been a very uniform section throughout, with healthy plants, though the results, when judged by the crops as given in the tables, do not indicate that dissolved bone black could replace bone meal or slag as a source of phosphoric acid.

The notes which have been taken on V. and W. from time to time state that these sections are quite uniform throughout, there being scarcely a perceptible difference between the various plots of the two sections. However, an examination of the tables of results will show that the crops obtained from these sections do not exceed the crops from sections treated with the same fertilizers, but which received only the two applications per year without variations. This would seem to indicate that increasing the number of applications per year beyond two, or three, at the most, and that varying the ratio of the fertilizing ingredients with the different applications, as was done on section W.⁷ are not necessary after the first year.

Section X. received the same treatment as section C., except that each plot received ten pounds extra bone meal at the beginning. The section has been a good one and the plants have been fairly uniform and in a healthy condition all the time. However, the extra bone does not seem to have given it any advantage over those fertilized in the same way but without the extra bone.

⁷ Beginning with 1905 the number of applications for this section was reduced to two.

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A STUDY OF THE CROP OF 1903.

The first crop was gathered in June and July of 1903 and was about 88 per cent. of the total possible crop. Diagram III. gives the total number, and number of different sizes of pines taken from each plot; the total number in the sections; and the total number in the plots occupying relatively the same position in the sections counting from left to right across the entire plot, for the years 1903, 1904, and 1905. A careful study of the crop for 1903 will yield some very interesting results. In at least half the sections there is a slight increase in the total number of pines from the first to the third plot of the sections. On the other hand there is but little difference between the number obtained from the third and fourth plots of the sections, indicating it would seem, that the limit of amount of plant food has been reached with the quantity applied to the third plot in each section, this amount as already stated being the same for all plots occupying the same relative position in the sections, reading from left to right. As further proof of this, the plants of the third plot in the sections have almost uniformly appeared as large, strong and healthy as those of the fourth plot, and in some instances they have been superior. By again referring to Diagram II. it will be seen that the third plot in all the sections, except those introduced for special purposes, received each year the equivalent of 3750 pounds per acre of a fertilizer analyzing 4 per cent. available phosphoric acid, 5 per cent. nitrogen and 10 per cent. potash, but in most cases representing a different source for at least one of the constituents. From the same diagram it will be seen that the fourth plot of the sections received 4500 pounds per acre of the same fertilizer. Judging, therefore, by the general appearance, and also from the results obtained from the plots, we are ready to conclude that 3750 pounds per acre, of a fertilizer analyzing as above, about approaches the limit for profitable results. And as we have already shown by section L., plot 47, that a mixture of bone, blood and high grade sulphate, with a percentage very closely approaching the 4, 5, 10 percentage which was adopted as the standard, and 3750 pounds to the acre, gave slightly better results than any of the other percentages tried, it seems safe to conclude that on the third plot

the sections we have the quantity and percentage of a fertilizer that will, in general, give the best results with pineapples on the east Coast of Florida, the proper materials, of course, being selected.

TABLE III.

Showing increase of 24's and decrease of 42's as fertilizer is increased—Crop of 1903.

[illegible]

♦ **Special plots.**

Table III, which shows the increase in 24's and decrease in 42's, as the fertilizer is increased, still further emphasizes this fact. For example, by reference to the table it will be seen that the total number of 24's in the third plots of the upper sections is 277, while the total number in the fourth plots, which received one-fifth more fertilizer than the third, is exactly the same—277. In the lower half, the total 24's in the third plots of the sections is 262, while in the fourth it is 269—only 7 more. A further study of this table will reveal the rapid increase of 24's from the first to the third plots of nearly all the sections, but as already pointed out this increase does not extend to the 4th plots in very many cases, while in some instances there is actually a decrease. On the other hand there is a decrease in 42's which is very decided from the first to the second plots of the sections but more gradual from the second to the fourth.

Assuming that the total number of pines on the third horizontal line of plots would have been the same as the total number on the first line, had the fertilizer not been increased on the third, we have a basis for calculating the increase in crop value due apparently to the quantity of fertilizer which was added to the third line of plots above that which was added to the first. By referring to the first column headed total in Table III, and taking the sum of the total number of 24's from the third line of plots, both upper and lower sections, it will be found to be 530, while the total from the first line of plots, both upper and lower sections, is 169, giving an increase on the 22⁸ plots apparently due to increase in fertilizer, of 370 pines or about 15½ crates. Since these plots are 1-150 of an acre the increase is at the rate of 105 3-5 crates per acre, which, at \$1.65⁹ per crate would amount to \$174.24. Again, referring to the same table it will be seen that the 42's have decreased from a total of 386 in the first line of plots to 114 in the third line, making a loss of 272 pines or 6½ crates for the 22 plots, which is at the rate of 44 1-3 crates per acre, which at \$1.10 would be worth \$48.77. Subtracting this from \$174.24 we have \$125.47 gain.

⁸ Sections V. and W. being intended for special purposes have been omitted from this count.

⁹ An experienced grower estimates that taking a series of years 18's would bring \$1.80, 24's and 30's \$1.65, 36's \$1.30, and 42's \$1.10 per crate.

due apparently to increasing the number of 24's by increasing the fertilizer about 3-4 of a ton per acre. To get the net gain we have but to deduct from this the cost of the extra fertilizer. Calculating the cost of the extra fertilizer added to the third line of plots, above what was added to the first, on the basis of the cost of the raw materials at the factory, we find it to be \$3.88 for the 22 plots, which is at the rate of \$26.45 per acre. Deducting this from \$125.47 leaves us a gain of \$99.02. From this must still be deducted the cost of mixing and the freight rate from Jacksonville to the pineapple district, and this would be, according to statement furnished by a manufacturer, \$3.79 per ton; and since the extra fertilizer required, amounts to about 3-4 of a ton, this charge would be \$2.85. Deducting this from \$99.02 would leave us a net profit per acre on the 24's of \$96.17.¹⁰ In the same way it may be shown that the increase in value of the 30's above the decrease of 36's is about \$11.80 and this is net gain, the fertilizers having already been accounted for. This makes the total net gain \$107.97. The gain in 18's was so slight that they were not taken into consideration in this case. But this does not represent the entire possible gain, since in an experiment some fertilizers are used in order that their unfitness for the particular crop may be demonstrated, and the results from such plots are necessarily lower than they would be under ordinary circumstances. This can be demonstrated by calculating the increase in value on one of the best plots. On examination we find that plot 19 of section E. has yielded a greater increase with increase of fertilizer than any other plot, as follows:

42 24's equivalent to	262 1/2 crates per acre @ \$1.65.....	\$433.12
17 30's equivalent to	85 crates per acre @ 1.65.....	140.25
Total gain on		
24's and 30's....	347 1/2 crates.	Value....\$573.37

The decrease in 36's and 42's is as follows:

8 36's equivalent to	33 1/3 crates per acre @ \$1.30.....	\$ 43.33
42 42's equivalent to	150 crates per acre @ 1.10.....	165.00
Total loss on		
36's and 42's....	183 1/3 crates.	Value....\$208.33

Subtracting this from \$573.37 gives us a gain per acre of \$365.04. To get the net gain we must still deduct from this

¹⁰ In making these calculations we have made them for the average year and not for the first crop, which would require a little more extra fertilizer than the 3/4 ton provided for.

PLATE XXII.



Plot No. 36—Slag Phosphate, Dried Blood, High Grade Sulphate.



Plot No. 44—Acid Phosphate, Dried Blood, High Grade Sulphate, Lime.

2000

PLATE XXIII.



Plot No. 53—Acid Phosphate, Nitrate of Soda, High Grade Sulphate.



Plot No. 64—Bone Meal, Nitrate of Soda, High Grade Sulphate.

4701

the cost of the extra fertilizer per acre, including the cost of mixing and the freight from Jacksonville, which for the materials used on this plot (see Diagram II., plot 19) would be \$25.88 (a little less than the average extra expense on the 22 plots), and this leaves \$339.16, clear gain per acre, obtained by increasing the fertilizer from 2250 to 3750 pounds. In this connection it will be of interest to learn which section¹¹ and which plot¹² have given the largest gross returns. On calculating the yield per section to yield per acre we find that section I. which received slag phosphate, blood and high grade sulphate gave the largest returns, as follows:

117 24's equivalent to 182.8	crates per acre @ \$1.65.....	\$301.62
176 30's equivalent to 220.0	crates per acre @ 1.65.....	363.00
83 36's equivalent to 86.46	crates per acre @ 1.30.....	112.40
10 42's equivalent to 9.00	crates per acre @ 1.10.....	9.90
Total..... 498.26 crates		\$786.92

That is, section I. has yielded at the rate of nearly 500 crates per acre which, at the price assumed, would amount to \$786.92. But the four plots of this section, as already explained, received their fertilizer in gradually increasing amounts, beginning with the first, and consequently this amount does not represent the yield per acre from the best plot. On examination it is found that plot 35, the third in section I., has given larger total returns than any other plot in the entire experiment as follows:

50 21's equivalent to 312 1/2	crates per acre @ \$1.65.....	\$515.625
35 30's equivalent to 175	crates per acre @ 1.65.....	288.750
12 36's equivalent to 50	crates per acre @ 1.30.....	65.000
Total..... 537 1/2 crates		\$869.375

Plot 36, the 4th of the same section, gives the following results:

3 18's equivalent to 25	crates per acre @ \$1.80.....	\$ 45.00
36 24's equivalent to 225	crates per acre @ 1.65.....	371.25
39 30's equivalent to 195	crates per acre @ 1.65.....	321.75
22 36's equivalent to 91.66	crates per acre @ 1.30.....	119.16
Total..... 536.66 crates		\$857.16

This bears out the statement already made that the limit

¹¹ To convert number per section to crates per acre, multiply by 1/4 of 150 or 37.5 and divide by the size.

¹² To convert number per plot to crates per acre, multiply by 150 and divide by the size.

of profitable fertilizing has been reached with the amount applied to the third plot of the sections.

Plot 47, section L., also furnishes some interesting facts. It will be remembered that this section was introduced for the purpose of ascertaining what is likely to prove the best ratio for phosphoric acid, nitrogen and potash. Already we have seen that the third plot of this section received these constituents in a ratio which more closely approaches the 4, 5, 10 ratio adopted for the experiment, than any of the other plots of this section, and also that it received the fertilizer at the rate of 3750 pounds per acre, which is the amount that has in most cases given the best results. And now in the crop from this plot we have still further evidence on this point. We find on examination that it has yielded larger returns than any other plot of the section and that it is not very far behind plots 35 and 36 of section I. The results are as follows:

38 24's equivalent to 237 1/2 crates per acre @ \$1.65.....	\$391.875
49 30's equivalent to 245 crates per acre @ 1.65.....	404.250
9 36's equivalent to 37 1/2 crates per acre @ 1.30.....	48.750
Total..... 520 crates	\$844.87

To return again to the yield per section, we find that several others approach very closely the yield of section I., as follows:

Section T at the rate of 487.76 crates per acre.....	Value \$771.03
Section P at the rate of 483.62 crates per acre.....	Value 769.72
Section E at the rate of 488.55 crates per acre.....	Value 766.25
Section M at the rate of 484.84 crates per acre.....	Value 763.94
Section O at the rate of 488.59 crates per acre.....	Value 763.30
Section Q* at the rate of 474.28 crates per acre.....	Value 756.40
Section U at the rate of 475.00 crates per acre.....	Value 750.00
Section V at the rate of 472.00 crates per acre.....	Value 740.33

Computing the value of two of the poorest sections we find them to be as follows:

Section B at the rate of 283.95 crates.....	Value \$428.44
Section R at the rate of 324.44 crates.....	Value 483.05

Computing the value of the poorest plot—plot 69 Section R.—we find it to be as follows:

24 30's equivalent to 120 crates per acre @ \$1.65.....	\$198.00
5 42's equivalent to 17.86 crates per acre @ 1.10.....	19.94
Total..... 137.86 crates	\$217.94

* Since the gathering of the first crop this section has deteriorated very greatly.

PLATE XXIV.



Plot No. 65—Slag Phosphate, Nitrate of Soda, High Grade Sulphate.



Plot No. 69—Bone Meal, Muriate.

PLATE XXV.



Plot No. 73—Bone Meal, High Grade Sulphate.



Plot No. 77—Bone Meal, Castor Pomace, High Grade Sulphate.

Comparing the best and poorest sections and the best and poorest plots we have the following results:

Best section—	I—498.26 crates per acre.....	Value	786.92
Poorest "	—B—283.95 crates per acre.....	Value	428.44
Difference.....	214.31 crates per acre.....	Value	\$358.48
Best plot—plot 35.....	537.50 crates per acre.....	Value	\$869.375
Poorest —plot 69.....	137.86 crates per acre.....	Value	217.640
Difference.....	399.64 crates per acre.....	Value	\$651.735

We believe, therefore, that the experiment fully demonstrates that there is good profit to those growing pineapples under shade on the East Coast, in applying as high as the equivalent of 3750 pounds per acre of a fertilizer analyzing 4 per cent. phosphoric acid, 5 per cent. nitrogen, and 10 per cent. potash, but that beyond this amount there is but little if any profit. Just how far this will apply to pineapples grown in the open we cannot say, though it seems to be generally conceded that less fertilizer is required under sheds than in the open, and this being the case. it is quite possible that the amount to be used in the open might profitably be increased beyond the amount here specified for sheds.

CROP OF 1904.

No such decisive conclusions can be drawn from the crops of 1904 and 1905, but this is undoubtedly due to causes other than fertilizers. The shortness of the crop for 1904 may possibly be attributed to the fact that the plants were somewhat exhausted from having yielded so full a crop in 1903. Certainly the fact that in many cases the plots receiving the least fertilizer gave the largest yield, would indicate that it was not want of fertilizer that caused the short crop. It would hardly seem fair to undertake to draw many conclusions from a crop which is less than one-third of a total possibility. Unfortunately, we failed to get a record of the fall and winter crop for either 1903 or 1904. Could this crop have been added to the summer crop for 1904, it is quite possible that the showing would have been different, as we would naturally expect so small a summer crop to be followed by a heavy fall and winter crop. The fall and winter crop for 1903 was small on account of the heavy summer crop, and therefore would not have materially affected the total.

CROP OF 1905.

The freeze of February, 1905, explains the shortage of the crop for this year, and again it would seem unfair to draw many conclusions, for undoubtedly the fertilizers had little to do with the falling off. At the same time a careful count will show that the number of 24's has been considerably increased on many of the plots as the fertilizer was increased, while the 42's were decreased but slightly. In the upper half of the plot (see Diagram III., crop of 1905), it will be noticed that the total number of pines has increased from the first to the third line of plots, while in the fourth the total is less than in the third line, again emphasizing the fact that the limit of profitable fertilizing has been reached with the third line. In the lower half of the experiment plot, there is a gradual decrease in the total from the first to the fourth line, but this may possibly be accounted for from the fact that several of these plots received fertilizers that proved injurious, and as the amount was increased the injurious effects were more pronounced.

A study of the table will bring out some other interesting facts. Sections A. and B. both of which received acid phosphate up to this year, each yielded less than 100 pines, while section K. which received the same treatment and lime in addition yielded 162 pines, an increase of over 60 per cent; this section produced the highest number of 24's. Section U. which was fertilized with dissolved bone black, dried blood and high grade sulphate gave the highest yield for this year, 168, while sections H. and I. with 152 and 153 respectively, and which received their phosphoric acid in the form of slag, closely follow section K. Section O. which also received slag is next, with 147. Sections G. and J. both of which received kainit yielded less than ten 24's, while section S. yielded only one.

THE FREEZE OF 1905.

After the freeze of February, 1905, the experiment plot was carefully examined, first by Mr. W. R. Hardee and later by one of us (Blair) to see whether plots fertilized differently had been differently affected, but no marked difference could be detected. True, some of the plots looked worse than others, but they were the plots that had already been injured by the treatment they

PLATE XXVI.



Plot No. 83—Dissolved Bone Black, Dried Blood, High Grade Sulphate.



Plot No. 89—Bone Meal, Dried Blood, High Grade Sulphate. Ratio Varied with the Different Applications.

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had received. Practically no difference, so far as the effect of the freeze was concerned, could be detected in the condition of those plots which had responded well to the treatment they were receiving.

Although the crop for this year was very much reduced, this statement is well borne out by the results. A further examination of the table reporting the crop for 1905 shows very clearly that the most of those plots which have already been reported as injured by the treatment they were receiving, for example sections A., B., G., J., R. and S., gave the lowest total number of fruits, or a very small number of the larger sizes, or both. Neither were we able to detect any difference in the effect upon those plots which received phosphoric acid, nitrogen and potash in varying ratios.

REMARKS.

It was assumed that an average of 1-3 and 1-4 of the total phosphoric acid in bone meal is available.

According to the method used for determining the available phosphoric acid in slag, approximately 1-3 of the total is available.

Slag tends to produce a rank growth of plants and it is possible that if a part of the slag should be replaced with bone meal better results would be obtained than with either alone.

While land plaster was not used in this experiment, except for one application, it is used by a number of the growers with good results. The claim is made that it tends to aid in fixing the nitrogen of organic fertilizers, such as dried blood and cottonseed meal. It is considered especially helpful in this respect if these organic fertilizers are applied during a dry spell. This claim is borne out by the work of a German investigator.¹⁸ He finds that land plaster not only assists in the rotting of manure, but that it also fixes or holds much ammonia that would otherwise escape. The conditions under which this investigator worked are, of course, not the conditions which exist in the pineapple belt, but it is not at all unlikely that the same chemical reactions take place. Those growers who have used land plaster put on about 200 pounds per acre.

¹⁸ S. A. Sewerin, Gips als ammoniakbindende Substanz bei der Verrottung des Stallmistes. Centralblatt für Bakteriologie, Par. u. Infek., XI. Bd., Nos. 12/13 und 14/15.

An effort was made, by analysis, to find out whether the fruit would show an increase in the elements of plant food as the fertilizers were increased, but the method of taking the samples tended to vitiate the results. It was not possible to make a composite sample of all the fruit from each plot, and to take two or three fruits from a plot, as was done, probably does not give average results. The results obtained do not warrant us in drawing any conclusions in regard to the relation which exists between the plant food in the soil and in the fruit. Indeed, it is quite possible that increasing the amount of plant food in the soil may not affect the quantity to be found in the fruit, but only that in the plant. The results are of interest as showing the amount of plant food removed by the fruit and will be found in Table IV. Given the weight of a crate of pineapples, and the number of crates per acre, it is a simple matter to calculate the plant food removed by a crop of pineapples.

TABLE IV.

Analyses of Pineapples from Experiment Plot showing Phosphoric Acid, Nitrogen and Potash in the Original Fruit.

STATION No.	P ₂ O ₅ per cent.	N per cent.	K ₂ O per cent.	STATION No.	P ₂ O ₅ per cent.	N per cent.	K ₂ O per cent.
1494	.0368	.0767	.2432	1524	.0417	.0605	.2330
1495	.0418	.0688	.2201	1526	.0339	.0580	.1980
1496	.0391	.0676	.1838	1527	.0404	.0621	.2470
1497	.0374	.0883	.2281	1531	.0395	.0633	.2179
1498	.0375	.0641	.2092	2532	.0455	.0760	.1822
1499	.0358	.0647	.2085	1534	.0522	.0704	.2198
1500	.0402	.0630	.2315	1537	.0508	.0648	.2283
1501	.0344	.0657	.2283	1538	.0497	.0650	.2347
1502	.0409	.0674	.2458	1539	.0386	.0638	.2474
1503	.0462	.0688	.2136	1540	.0429	.0691	.2111
1504	.0471	.0835	.2049	1541	.0563	.0742	.2581
1505	.0410	.0694	.2095	1542	.0392	.0667	.2177
1506	.0420	.0781	.2182	1543	.0432	.0662	.2513
1507	.0484	.0859	.2138	1544	.0477	.0650	.2716
1508	.0369	.0727	.1883	1545	.0482	.0796	.2585
1509	.0369	.0795	.2010	1551	.0430	.0692	.2312
1510	.0381	.0710	.2187	1552	.0450	.0697	.1955
1512	.0434	.0666	.2148	1553	.0429	.0680	.2876
1518	.0433	.0757	.2545	1554	.0443	.0789	.2320
1519	.0421	.0929	.2475	1555	.0451	.0698	.2553
1520	.0390	.0669	.2197	1556	.0416	.0703	.1868
1521	.0426	.0736	.2361	1557	.0398	.0658	.2090
1522	.0390	.0765	.2288	1558	.0429	.0664	.2244
1523	.0401	.0706	.2384	1559	.0451	.0724	.2259
Average					.0423	.0707	.2256

Some work has also been done looking towards ascertaining whether increasing the fertilizers has any effect upon the sugar and acid content of the pineapple, but this work is not yet complete.

For the beginner in pineapple growing there will be many details which must be learned by experience or from the practical grower. The experimenter is, of necessity, obliged to content himself largely with working out general principles, since different localities and different individuals require that different methods be employed in executing many of the minor details in almost all agricultural pursuits.

RECOMMENDATIONS AND CONCLUSIONS.

In making recommendations, we cannot undertake to lay down hard-and-fast rules except perhaps in very few cases, since the personal equation must necessarily count for much in the growing of pineapples. Some will get good results with one method and one kind of fertilizer, while another may pursue entirely different methods and use different fertilizers and still get good results. However, some points seem to be pretty well established, viz:

As a source of phosphoric acid, fine ground steamed bone has given very general satisfaction, while both bone meal and slag phosphate have given good results in our experimental work. If acid phosphate is used, lime should be added every year or two, at the rate of about 750 pounds to the acre. Dissolved bone black may be used if it is known to be genuine. However, as previously stated, it may be well to avoid these two sources of phosphorus.

As sources of nitrogen, dried blood, cottonseed meal and castor pomace may be used. Nitrate of soda may be used for the first six months and possibly, to a limited extent, for the first year, but after the first year it will probably be safer to eliminate it entirely. Considerable caution is required in its use.

Of the potash salts used, high and low grade sulphate have given the best results, the latter seeming slightly the better. Muriate has given fair results, though the sulphate undoubtedly gives better results. Kainit should not be

used. High grade tobacco stems, though not used in this experiment, have been used by a number of growers with good results.

The plot giving the greatest increase in value for the summer crop of 1903, due to increase of fertilizer, was No. 19, Section E., fertilized with bone meal, dried blood, and low grade sulphate of potash, the net increase being at the rate of \$339.16 per acre.

The plot giving the largest total returns, for the summer crop of 1903, was plot No. 35, Sec. I., fertilized with slag, dried blood and high grade sulphate of potash. This plot yielded at the rate of 537 1-2 crates per acre; valued at \$869.37 1-2.

The poorest plot for the same year, No. 69, fertilized with bone meal and muriate of potash, yielded at the rate of 137 4-5 crates per acre; valued at \$217.64. The difference in favor of the best plot is, therefore, 399 3-5 crates; valued at \$651.73 1-2.

For most of the East Coast soils we would recommend 3500 to 4000 pounds to the acre annually of a fertilizer analyzing 4 per cent. available phosphoric acid, 5 per cent. nitrogen and 10 per cent. potash, to be applied at the rate of four applications a year for the first 18 months, and after this two applications a year; one in February or March as the conditions may require, and one soon after the removal of the summer crop. However, some very successful growers recommend three applications a year, as follows: about 1400 pounds of a standard fertilizer in February and again after the removal of the summer crop, and 1000 to 1200 pounds high grade tobacco stems in the fall or early winter. A regular application of a growing fertilizer at the beginning of winter has been found objectionable, in that the plants, if started to growing rapidly, are much more susceptible to injury by the cold weather which may come in January or February. This was clearly demonstrated by the freeze of 1905. Those who fertilized heavily in the late fall suffered more than those who did not fertilize at this time or who used only ground tobacco

stems. The tobacco does not cause much growth, but makes the plants hardy and thus better able to stand the cold.

Within three weeks, or as soon as possible after setting out, the plants should have a light application of cottonseed meal in the bud, about a tablespoonful to the plant. The first regular application should be put on broadcast about six weeks later, and be thoroughly worked in with the scuffle hoe. For this application, some growers have used castor pomace or cottonseed meal, and high grade tobacco stems, with good results.

The experiment has clearly demonstrated that by increasing the fertilizer from a little more than a ton, to nearly two tons per acre, we increase the number of larger sizes of pineapples to a very profitable extent, and that for shedded pines there is no profit in going much beyond this amount.

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BULLETIN No. 84

MARCH, 1906

• FLORIDA •
AGRICULTURAL EXPERIMENT STATION.

Pineapple Culture IV.--Handling the Crop



Photo by H. G. Dorsey.

Picking Pineapples at Jensen, Florida.

By H. HAROLD HUME.

(Formerly Horticulturist of the Florida Station; now Horticulturist of the North Carolina Department of Agriculture and the North Carolina Experiment Station.)

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PINEAPPLE CULTURE IV.---HANDLING THE CROP.

INTRODUCTION.

The evolution of the methods of preparing pineapples for market has covered a period of about twenty years. From a crude beginning, the methods have gradually changed from year to year until now the care given to the handling of the pineapple crop will compare favorably with that bestowed upon any other fruit found in our fruit markets.

At first, pineapples were shipped in old or discarded barrels with holes chopped in their staves to ensure ventilation. An old jute sack put over the top and held in place by the top hoop served as a cover. About 1890 the barrel crate, 12 by 20 by 36 inches, was in use and continued to be used until discarded in favor of the crate, holding approximately a half barrel, measuring $10\frac{1}{2}$ by 12 by 36 inches. This crate is still in use. The crates at first were marked with a pencil or brush, but finally the rubber stamp was introduced.

In the packing of pineapples in the early days, no wrapping paper was used. Then common newspapers were used for wrapping. These were followed by plain manilla sheets and finally colored and stamped paper came into vogue.

The first pineapples (1885 and later) were shipped by sail boat on the Indian River to Titusville, thence they were hauled across to the St. Johns River to be loaded on the steamer. It was not until the present territory was opened up by the railroad that the pineapple industry took rank among the important horticultural crops of the State.

PACKING HOUSES AND EQUIPMENT.

The pineapple packing house should be so arranged as to give every possible convenience for handling the fruit. The picking season is usually quite short, the bulk of the fruit being removed in about three weeks. During this time the fruit must be moved rapidly to prevent its becoming overripe and a conveniently arranged packing house goes a long way in facilitating the work.

As a general principle the fruit should enter at one end or

side of the building, and as the several steps in the process of packing are performed it should be moved away from the point of entry. The packing house should be constructed so as to render lifting the fruit or packed crates unnecessary. Plenty of light, air and good protection against heat should be afforded. If the house can be placed close beside a side track, so as to load the packed crates directly into the car, it will be found very convenient, as well as less expensive.

The packing house need not be expensive, but it should be well and substantially built. Two convenient houses have been erected by Mr. C. T. McCarty, President of the Florida State Horticultural Society, Eldred, Fla. The first of these is two stories high, 40 feet long and 20 feet wide, surrounded by a platform 8 feet wide. This platform is protected on the east and west by 8 feet of overhanging roof. This gives a protected platform 80 feet long and 8 feet wide. Inside the fruit bin extends along one side the entire length of the building (40 feet). It is 3 feet wide, 16 inches deep and holds one hundred and twenty-five crates of pineapples when full.

The upper story holds 1000 crates made up and there is sufficient floor space below to hold 3500 crates at the same time, leaving plenty of room for crate making, packing and heading up. The entire east side can be opened up to admit air and take in fruit. This is done by a series of windows hung on pulleys and operated from inside. The fruit is brought from the field in wheelbarrows. The south end and west side are provided with six-foot sliding doors. Such a packing house can be used in handling a crop of 3500 to 4500 crates conveniently, and costs \$600.

The second house is larger, 50 by 20 feet, two stories high. The roof projects twelve feet, the platform along one side only beneath the projection is four feet wide. The south end is provided with a six-foot platform. The fruit bin at present extends the length of the building, three feet wide, two feet high from the floor, twelve inches deep, and will hold one hundred and fifty crates.

Just over the fruit bin are eight windows, four feet by four feet, provided with shutters. These shutters swing outward and upward, being held up by ropes provided for that purpose. The fruit is brought in from the fields in wagons, unloaded on the

PLATE XXVII.

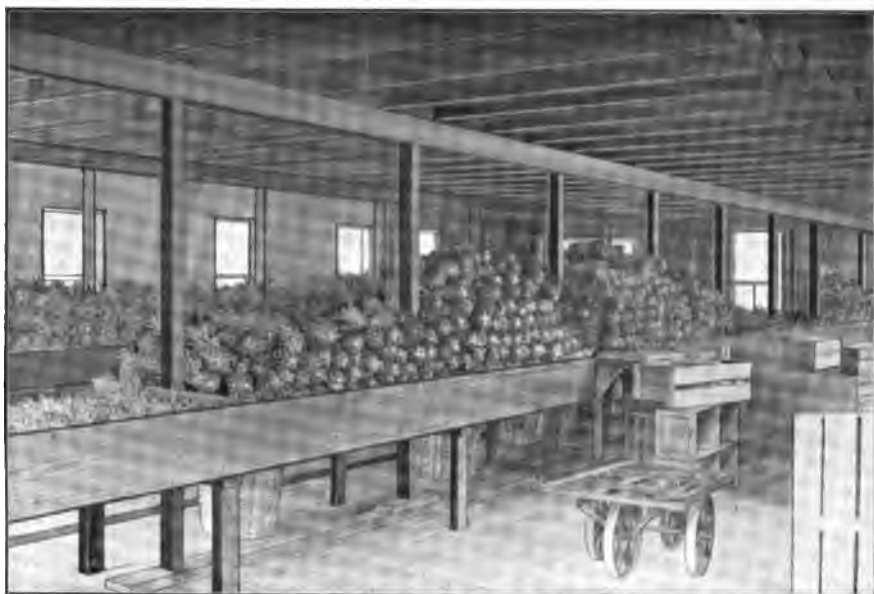


Photo by W. Hardee.

Interior of Packing House of R. D. Hoke at Jensen, Showing Arrangements for Handling Large Quantities of Fruit.



Photo by H. Harold Hume.

PLATE XXVIII.



Photo by H. Harold Hume.

Bringing in Pineapples with Wheelbarrows.



Photo by H. G. Dorsey.

A Car Propelled By a Gasoline Engine.

platform outside just under the windows and emptied through them into the fruit bin inside. In the north end there are two windows similar to those over the fruit bin. In the south there is one window and one sliding door and two sliding doors and two windows on the west side. The sliding doors are six feet by six feet. The upper story of the building gives ample room for crate making and storage of crate material. It will hold about 1500 made-up crates. This building cost complete about \$1000.

PACKING TABLES.—These are placed along side the fruit bins to hold the crates while they are being packed. A smaller one sometimes stands between the packing table and the bin and in front of the packer to serve as a wrapping table. (See Plate XXVII.) A convenient length for the packing table is about eight feet. It should be made twenty-seven inches high and fifteen and a half inches wide.

NAILING TABLES.—For placing the heads on the crates a slightly lower table (twenty-one inches high) of the same width should be provided. As the crates are packed they are slid off onto the nailing table and there headed up. One man will nail up about as rapidly as two can pack.

PAPER TRAYS.—Trays for holding the wrapping paper should be provided. If substantially built, these will serve as wrapping tables as well.

The tray should be slightly wider and a couple of inches longer than the paper. It should be made so as to hang on the edge of the fruit bin in such a way as to permit of its being shoved along from one place to another.

FIELD EQUIPMENT.

WHEELBARROWS.—For bringing the fruit in from the field, an ordinary wheelbarrow is frequently used. It should be light, but strongly built and, provided with a rack, two feet high. Such a wheelbarrow will hold three or four crates of pineapples. The wheel should be four inches wide to prevent its sinking in the yielding sand. A plank track should be provided if the wheel be any narrower, and at any rate, planks should be laid down in the main trails.

TRACKS AND CARS.—Tracks may be laid through the field

and provided with proper switches. This makes one of the most convenient methods of bringing large quantities of fruit to the packing-house.

The track can be made of 2 by 4 inch or 3 by 3 inch scantlings. The cross ties may be made of the same material. Cars can be made by anyone at all handy with tools, ordinary tram car trucks, or such as are used on hand-cars being used for wheels and axles.

In many parts of the pineapple district the natural fall of the ground is sufficient to permit of the loaded cars being brought to the packing-house by simply allowing them to slide down hill. A brake should be provided, to be managed by one man riding on the back of the car. The empty cars can be returned by man power, unless the incline is very steep.

Mule power may be used. If a mule or horse is used a path can be made alongside the track for the animal, or the space between the cross ties may be filled in to make a level path. Occasionally a small gasoline engine is used as the propelling power, an excellent plan where large quantities of fruit have to be transported any considerable distance.

BASKETS.—Bushel baskets may be used in gathering the fruit, i. e., in bringing it from the beds to the tram cars, or even in some cases to the packing-house. The baskets should be strong and well made. (See Frontispiece).

MITTS AND LEGGINGS.—For the protection of the hands and clothing of the pickers some covering is necessary. Leather has not proven satisfactory owing to its expensiveness and to the material increase of heat owing to its not allowing the air to pass through it. Nothing has proven better than heavy weight duck (ten ounce).

The mitts should fit loosely and should be made with sufficient "wrist" to afford ample protection to the forearm of the pickers. The leggings are made of sufficient length to cover the whole leg of the wearer, projecting up on the outer side to the waist and attached around the waist with a string, or attached to the suspenders.

WHEN TO PICK.

That portion of the crop gathered in winter should be allowed to reach a greater degree of maturity than in summer. The

PLATE XXIX.



Photo by H. G. Dorsey.

Track and "Switch" or Turn Table Used in the Pineapple Fields.



Photo by H. Harold Hume.

Unloading Pineapples at the Packing House. Showing Cars—Note Brake on the Rear One.

1

reasons briefly are these: In winter the amount of sugar developed in the fruit is less than in summer and to secure good edible quality it should be allowed to remain on the plant as long as possible. The winter fruit, because of weather conditions, does not become overripe so rapidly and the yellow exterior is not an indication of the same degree of ripeness as in summer. In winter the fruit may be left on the plants until it has become slightly colored in the case of Cayenne or quite colored as in Spanish pineapples.

Just before the pineapple reaches full maturity it is dark, black green in color and the eyes are somewhat pointed and angular. As it matures the eyes flatten down somewhat in the center and become slightly elevated around the margins, while the color changes to a very pale green. The opening and spreading of the crown may be taken as one the best indications of maturity. To the veteran picker the length of the fruit stem, the size and length of the slips are a good general guide of the stage of maturity. As the fruit ripens its stem elongates, the slips grow rapidly and their leaves spread out. In looking for evidences of maturity the basal eyes of the fruit should be closely examined as the pineapple ripens from the base upwards as well as from the core outward.

In the summer if intended for short distance shipments and immediate consumption, the basal eyes may be allowed to attain some color. If a considerable time is to elapse between picking and consumption in summer, the fruit should not be quite so mature. Fruit of good quality, judiciously grown on good land, judiciously fertilized, may be allowed to become riper than fruit not grown under such favorable conditions.

There is a tendency toward shipping fruit too green. This should be guarded against. A pineapple ripened in a freight train, in a crate or on a fruit stand is never so good as one allowed to ripen on the plant. The consumer should be given the best flavor and quality. It will make him want more.

HOW TO PICK.

Spanish pineapples can be broken from the plants without injury to the fruit. A quick, sharp jerk, using the crown as a handle brings them off. Other varieties, such as Cayenne, and

particularly Porto Rico and Abbachi are not so easily handled. If the last two varieties are broken off they frequently "plug" up into the fruit, i. e., the stem breaks off a short distance up into the fruit, leaving the flesh exposed. The only way to get around this difficulty is to use a knife and cut them off the stems.

The fruit may be taken out of the beds in armfulls and laid in the walks to be taken up afterwards. This must usually be done under sheds. In the open field, however, the best plan, and the one usually followed, is for the picker to break the fruit off and throw it to his helper who stands in the walk between the beds, catches it and places it in his wheelbarrow or basket. (See Frontispiece.)

PINEAPPLE PACKAGES.

At the present time two different standards of size for pineapple crates are in use in Florida. It would perhaps be better were there only one, but so long as there is such a wide variation in size of the different varieties of fruit shipped, so long will there be a demand for the fancy pineapple crate. The demand has been made necessary owing to the larger size of the fruit of some varieties and their crowns.

But whatever the size of crate in use it should be of the exact standard size and should not vary much, even the fraction of an inch one way or another. The wood used in making them should be bright, clean and attractive. The sale of any fruit is injured by being placed on the market in dirty, or uninviting packages. In the damp climate of Florida the packages are subject to mildew if left exposed to the weather. As soon as the shipment is received it should be placed under cover, the loft of the packing house being frequently used for the purpose. This makes some unnecessary labor, and if possible the packing house should be so arranged as to place the packing room and the materials bought for packages on one and the same floor. But if the crates can be made in the loft this objection is largely overcome.

One of the objections which was formerly urged against the panel head was that it warped so readily, but this objection can be overcome if the material is immediately put under cover. If left exposed to the rains and dews they will warp past recognition and be totally worthless.

SIZE OF THE CRATE.—The pineapple crate used throughout the Florida East Coast for Spanish pineapples is made of pine 12 inches wide, 10½ inches deep and 36 inches long. There is a partition in the middle, the ends and partition being either solid or paneled and 7-8 of an inch or 1 1-8 inch thick. The top, bottom and sides are made of two slats each 5-16 inch thick and 4 1-2 inches wide.

Materials required for Spanish Pineapple Crate:

2 heads 12 by 10 1-2 inch by 1 1-8 inch.

1 partition 12 by 10 1-2 inch by 1 3-8 or 7-8 inch.

8 slats 4 1-2 by 5-16 inch by 36 inch.

These materials are shipped from the factories or dealers, "knocked down" in bundles and cost about \$11.50 per hundred in carload lots of 1700.

FANCY PINEAPPLE CRATE.—The crate used in shipping the large varieties of pineapples, such as Cayenne and Porto Rico, is different in size and shape from that commonly used for the Spanish variety. It measures outside 12 1-2 inches wide, 20 1-2 inches deep and 24 inches long. The inside measurements are 12 inches wide, 20 inches deep, 22 inches long. The sides, top and bottom are each 5-16 inch thick, the ends are paneled 1 inch thick and no partition is used.

Materials required for Fancy Crate:

2 heads 12 by 20 inch by 1 inch.

4 slats (sides) 8 1-2 by 5-16 inches by 24 inches.

4 slats (top and bottom) 4 1-2 by 5-16 inches by 24 inches.

These materials cost knocked down, about \$20.00 per hundred crates.

PAPER.—Each individual pineapple should be wrapped before placing in the crate. The paper used for this should be heavy and glazed. If not glazed it absorbs moisture and tears too readily. The size commonly used in wrapping the Spanish pineapple is 15 by 20 inch, and such paper will cost from \$1.00 to \$1.45 per 1000, depending upon the quality. For wrapping fancy pineapples a sheet about 15 by 18 inches is in common use.

In the use of paper there is considerable room for the ingenuity and individuality of the grower. Various fancy brands may be used to advantage. One of the most decided early im-

provements in the way of paper was a colored paper, which for a number of years was used by a grower of the East Coast. This paper was of a peculiar and particular color and no doubt had considerable to do with the prices secured by him in advance of those received by his neighbors. It pays to give attention to these small details and anything which will add 2 or 3 cents to the value of a package in the market over what it costs to put it up should, of course, be undertaken. By no means should a soft, unglazed paper be used, as it absorbs moisture readily and tears easily in consequence. If colored paper is used it should only be of the very best quality, because if of poor quality and it becomes moist or wet it may stain or discolor the fruit.

GRADING.

The grading of pineapples at the time of packing is not a difficult matter. Specimens injured by rats, misshapen specimens and crownless fruits should not be packed unless they can be sold in the local market. Rat-injured fruit should usually be consigned to the cull heap, as an opening made in the fruit will cause it to decay and rot prematurely. The abnormally small specimens should not be shipped, and it is sometimes questionable as to whether the 48 size pack should be used, although they take in the markets. There is no question, however, that the small sized fruit will count against the marketing of fair and large sized specimens.

The fruit in packing should be carefully graded as to size. For this purpose no machinery can be used, the eye of the packer must be the sole and only guide. The sizes for the different packs of Spanish pineapples are about as follows:

18 to the crate, 5 1-8 by 6 7-8 inches.

24 to the crate, 4 5-8 by 4 15-16 inch by 5 3-8 inch.

30 to the crate, 4 1-2 by 5 1-4 inch or 4 1-4 by 5 7-16 inch.

36 to the crate, 4 1-8 by 4 7-8 inches or 3 15-16 by 4 5-8 inches.

42 to the crate, 3 3-4 by 4 3-16 inches or 3 5-8 by 4 1-4 inches.

48 to the crate, 3 1-2 by 3 3-4 inches or 3 7-16 by 4 inches.

These dimensions cannot, of course, be regarded as absolute, but give a fair indication as to the size of the fruit for the several

packs. The crown of the fruit is, of course, not included in the above measurements.

The fruit put into each package should approach as nearly as possible a uniform size. It is not good policy to put very large and small fruit into the same package. Occasionally a package may be packed, however, with two different sizes in the different apartments, but if this be done the fact should be indicated on the end of the crate.

PACKING DIAGRAMS.

As in the packing of citrus fruits, so in the packing of pineapples. In order to fill the crates full of fruit a uniform size it has to be put in according to different arrangements. Such arrangements are usually referred to as packing diagrams. These arrangements, or diagrams, for the different packs of pineapples are as follows:

Pack 18, 3 layers of 3 each in each end.

Pack 24, 3 layers of 4 each in each end.

Pack 30, 3 tiers of 5 each in each end.

Pack 36, 3 layers of 6 each in each end.

Pack 42, 3 layers of 7 each in each end.

Pack 48, 3 layers of 8 each in each end.

The first layer should be placed in the crate with the crowns away from the packer, the second with the crowns reversed, and so on alternating until the crate is full. Each upper layer should cover the spaces between the fruit in the layer immediately beneath. For many years the packing was done by each individual grower and, of course, this holds to a certain degree still, although the professional pineapple packer is one of the more recent developments of the industry.

PACKING THE FRUIT.

With one hand the packer draws out a piece of paper from the tray, with the other reaches for a pineapple from the pile besides him and sets it on the paper. Then with a roll and a dexterous twist, wraps the paper about it. The fruit is then ready for the crate.

Place the different sized fruit in the crate according to the different packs. When the crate is completed, the fruit should not shake or rattle, the whole package should be per-

fectly solid. Fill the crate with all the fruit it will hold of the particular size being packed, should be the rule. Select the fruit in such a way as to fill the crate, don't wrap three or four sheets of paper around a fruit to bring it up to the size. When packed the fruit should stand flush with the ends and partitions of the crate, or a little above them.

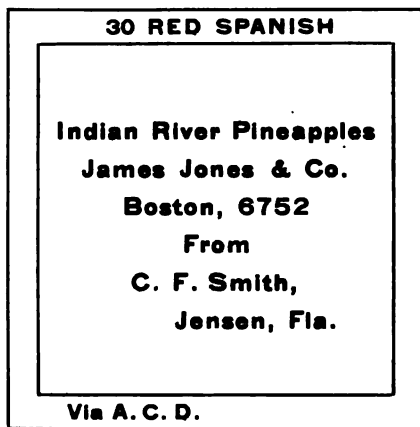
HEADING UP.

As soon as the crates are packed they are ready for the cover. The box should be placed on a low table, the slats laid on, nailed at one end, pressed down and nailed to the partition and the other head. Four-penny cement coated nails, running 75,000 to the keg, should be used. One man can nail up as quickly as two or three can pack.

STENCILING.

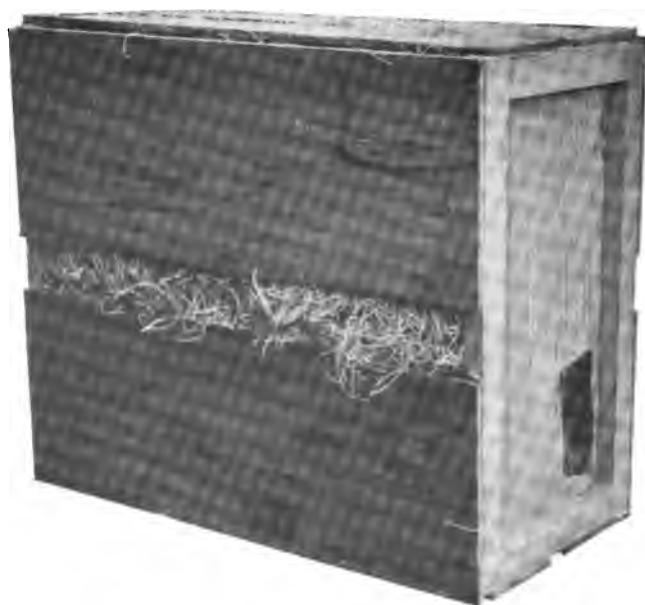
The marking of the crates may occasionally be left until the day's work is done, though in this as in many other matters pertaining to the handling of the crop, train schedules will govern.

The end of the crate should bear the number of pineapples, the name of the variety, the name of the consignee and the consignor and the shipping directions. When the stenciling is completed the end of the crate will be something like this:



If the box contains two different sizes, the fact should be so indicated on the end of the crate.

PLATE XXX.



Fancy Pineapple Crate. The Pineapples are Packed in Excelsior.



U.S.D.A.

11/11/11

Some growers cover the panel of one end of the crate with a fancy poster, which adds considerably to the appearance of the package.

COST OF PICKING AND PACKING.

The cost of picking, wrapping and packing pineapples, including paper, nails, crates and all is approximately twenty-five cents per crate.

SHIPPING.

Pineapples may be forwarded to the large northern markets by express, by all-rail freight, or partly by rail and partly by steamer.

Express shipments would be the ideal way for forwarding pineapples as the fruit could then be allowed to become more nearly matured before picking, but the express rates are prohibitive. In fact, the high rates of expressage have had much to do with the falling off of the pineapple industry at various inland points. Moreover, express shipments cannot usually be sent through to their destination in solid cars. Such fruit as is shipped by express must usually be transferred a number of times. The time allowed by train connections for transferring expressage is usually very short, consequently the crates receive extremely rough handling and many of them are broken.

Since express shipments are out of the question, the next best plan is to ship by freight in car load lots. This insures more rapid transportation and cheaper rates than if smaller shipments are made. Two or three neighbors may combine and load a car, in case one cannot do so alone.

All-rail shipments should reach New York from Fort Pierce, near the northern edge of the pineapple belt, in five days; Boston in six days; Philadelphia in four and one-half days. By water from Jacksonville the time averages one or two days longer.

LOADING THE CAR.

A car load is 300 crates, though the car load rate may apply to 250 crates; the maximum should not exceed 360 crates.

In loading the car for all-rail shipments, place six crates across the end on their flat sides and two and a half to three inches apart. On top at front edge of this layer place a slat one-

half inch thick by three inches wide; cut so as to exactly fit into the car crosswise. Put one nail through this into the slat of each crate, continue this five tiers high for a 300 crate car and six tiers high for 360 crate car, placing 150 or 180 crates in each end of the car, as the case may be. (See illustration as representing a car partly loaded for shipment to be transferred at Jacksonville, in which case the crates are not nailed down.) When the crates are all in, a passage about two and one-half feet wide is left in the center of the car between the doors. These spaces must be braced to prevent the crates from slipping and falling. Across the face of the top layer at the center, bottom and top tack a board 1 by 5 inches, then with short pieces brace diagonally across between filling in the two one-half feet spaces with sufficient braces to prevent slipping. It will be noticed that no slats are to be nailed across the crates except at the front ends. This leaves the top upper tier of crates two and one-half inches higher than those at the back ends of the car, which will assist considerably in preventing shifting.

SHIPPING ROUTES AND RATES.

The shipping routes for pineapples from the east coast of Florida to the northern markets are as follows:

RAIL AND STEAMER.

1. Florida East Coast Railroad and Ocean Steamship Company.
2. Florida East Coast Railroad and Merchant and Miners Transportation Company.
3. Florida East Coast Railroad and Clyde Line Steamship.
4. Florida East Coast Railroad, Atlantic Coast Line (Norfolk) Merchant & Miners Transportation Company.

ALL-RAIL.

5. Atlantic Coast Dispatch.

The rates beyond Jacksonville, Fla., to New York, Philadelphia and Boston by routes one, two and three is thirty-five cents per crate, by routes four, forty-five and one-half cents, while the all-rail (A. C. D.) is forty-eight and one-half cents to Philadelphia, fifty cents to New York and fifty-eight and one-half cents to Boston.

PLATE XXXI.



Photo by Hill.

Interior of Loaded Car. Shipment to be Transferred at Jacksonville. Loaded by
C. T. McCarty, Eldred, Fla.

U.S. 100

1000

The rates to Jacksonville on the Florida East Coast Railroad from various points are as follows:

<i>Stations.</i>	<i>Rate.</i>
Roseland to Vero (inclusive)	22c.
Oslo to Ankona (inclusive)	23c.
Tibballs to Aberdeen (inclusive)	24c.
Gomez to West Jupiter (inclusive)	25c.
Prairie to Hypoluxo (inclusive)	28c.
Boynton to Deerfield (inclusive)	30c.
Pompano to Dania (inclusive)	32c.
Hallandale to Miami (inclusive)	33c.

The facilities throughout the pineapple belt for loading pineapples could scarcely be improved upon, sidings and loading stations are placed so that the hauls are always short, there being in some cases four or five or more loading stations in every two or three miles.

MARKETING.

Pineapples are marketed in one of four ways, either by selling them at the packing house, by shipping them to a commission house, selling through an association, or selling through a broker.

SELLING AT HOME.—If the fruit can be sold at a fair figure at the packing house, it is usually best to take it. Then someone else than the grower has to assume the responsibility of market fluctuations and delays in transportations. Frequently the crop is sold in advance at a certain fixed rate per crate. Such contracts usually cover the fruit harvested within a certain period.

PRIVATE TRADE.—The private trade in pineapples has assumed considerable proportions. To the larger grower this method of marketing pineapples is not very inviting owing to the extra amount of time and care required. But it is worthy the serious consideration of the small grower.

The fruit supplied to a private trade should be of the best quality, carefully selected, neatly and tastefully packed. In dealing with private customers every effort should be made to give the same grade of fruit in every order. Uniformity is absolutely necessary in holding the good will and confidence of a private customer.

All packages for the private trade must usually go forward by express.

COMMISSION MERCHANTS.—The bulk of the pineapple crop is handled either directly or indirectly by the commission mer-

chants. The main objection to the commission merchant system of selling fruit, is that the grower has to place himself entirely in his hands. There seems, however, no way of overcoming this objection. There are honest men in the commission business, as large a proportion as in any other line of endeavor, and there are always ways and means for finding out which are the honest, responsible houses and which are not. Select a good house and stick to it. We know pineapple growers who have been shipping every season to the same firm for fifteen years and more.

In shipping to commission merchants, the best policy is to select one reliable man in each market to which shipments are to be made and ship to him alone. Do not split a shipment in any one market, sending part of it to one man, part to another. It is not fair to the merchant and will result in loss to the shipper.

Try to work with the commission man. If he wants riper fruit, send it to him, if not so ripe, let him have it. He knows the market as the grower cannot. Try to give him what he wants.

SPASMODIC SHIPMENTS.—A grower shipping to New York learns that pineapples are worth more in Boston than they are in New York. He ships there, but by the time his fruit arrives, the price has dropped and he gets the same or less than he would have got in New York. The price at which the market stands when the fruit is shipped is seldom the exact price at which the fruit is sold when it arrives. It does not pay to ship first to one market, then to another in the hope of getting the top prices always. Low prices will probably be obtained more frequently than if the fruit is regularly sent forward into certain markets, regardless of prices. One who ships according to this rule will usually come out at the end of the season with more money to his credit than will the one who chases about from one market to another in the hope of securing the best prices.

The following receipts, taken from the books of a pineapple grower, go to show that there is after all but little difference in the markets, from day to day:

<i>Date.</i>	<i>Market.</i>	<i>Shipment.</i>	<i>Net receipts.</i>	<i>Average.</i>
May 27, 1904,	New York	20 crates	\$35 47	\$1 27
May 27, 1904,	Philadelphia	15 crates	20 15	1 34
June 4, 1904,	New York	50 crates	66 13	1 32
June 4, 1904,	Boston	103 crates	138 56	1 34
June 4, 1904,	Philadelphia	54 crates	99 77	1 86
June 8, 1904,	New York	27 crates	43 48	1 61
June 8, 1904,	Boston	33 crates	49 50	1 50
June 8, 1904,	Philadelphia	26 crates	45 76	1 76
June 13, 1905,	Boston	94 crates	169 88	1 80
June 15, 1905,	Boston	158 crates	286 95	1 81
June 15, 1905,	Philadelphia	100 crates	194 94	1 95
June 17, 1905,	Boston	66 crates	122 85	1 86
June 17, 1905,	New York	100 crates	190 28	1 90
June 19, 1905,	New York	100 crates	187 62	1 87
June 19, 1905,	Philadelphia	150 crates	241 65	1 61
June 20, 1905,	Philadelphia	150 crates	155 51	1 03

Select a number of markets, one or more, as many as can be given a fair amount of fruit, and ship to them right along, week in and week out, day in and day out.

ASSOCIATIONS.—If an association can be formed for the mutual benefit of the growers it is an excellent thing. Too frequently, however, they go to pieces and the work amounts to nothing. The weak point seems to be that the association undertakes to do too much. The only association known to the writer which has proved successful is one which looks to the protection of the grower, without destroying his individuality and independence.

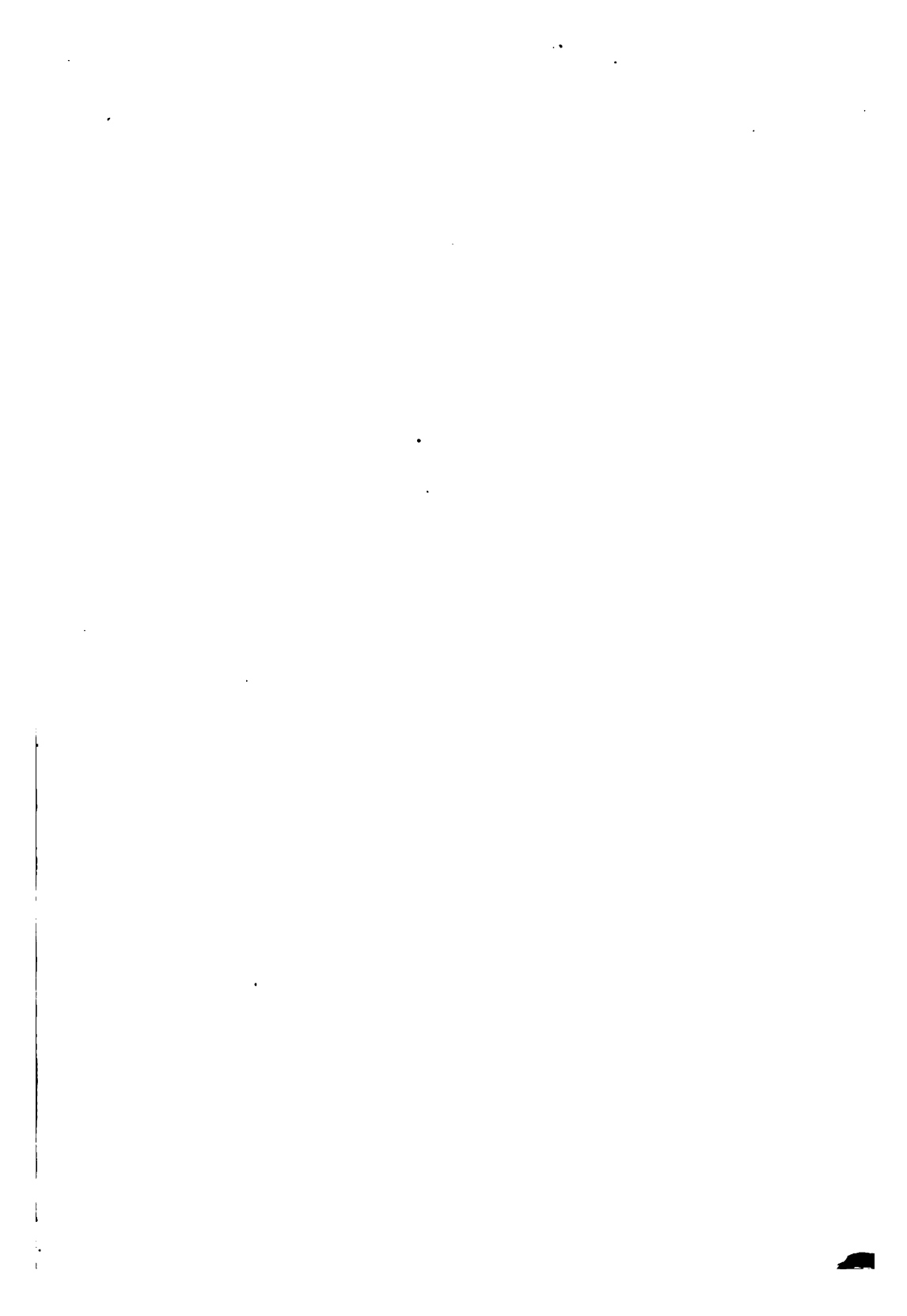
BROKERAGE.—In selling by the brokerage system, the fruit is placed in the hands of a fruit broker, who has the power to sell or consign as he deems best, a charge of ten cents per crate being made for handling. The grower then turns over the responsibility of marketing entirely to another person. The system possesses no advantages for the person who feels equal to the task of marketing his own fruit.

Bulletins of the Florida Agricultural Experiment Station.

NO.	AUTHOR.	TITLE.	DATE.
3.	J. Kost.....	General	May and June, 1888.
4.	Jas. P. DePass.....	General	January, 1889.
11.	Jas. P. DePass.....	General	October, 1890.
12.	Jas. P. DePass.....	General	January 1st, 1891.
13.	Jas. P. DePass.....	General	April, 1891.
16.	Jas. P. DePass.....	General Farm Crops.....	January 1, 1892.
17.	Jas. P. DePass.....	General	April, 1892.
19.	Jas. P. DePass.....	Tobacco	October, 1892.
22.	A. A. Persons.....	Fertilizers	November, 1893.
24.	O. Clute.....	Annual Report.....	January, 1894.
25.	A. W. Bitting.....	Leeches and Leeching.....	September, 1894.
26.	A. W. Bitting.....	Big Head.....	October, 1894.
27.	L. A. Washbourne.....	Pineapple	November, 1894.
28.	A. W. Bitting.....	Liver Fluke — Southern Cattle Fever	December, 1894.
30.	F. B. Moodie.....	The Culture of Tobacco.....	November, 1895.
32.	A. A. Persons.....	Cotton and Its Cultivation.....	January, 1896.
33.	M. S. Moreman.....	Orange Groves.....	February, 1896.
34.	A. L. Quaintance.....	Insect Remedies.....	March, 1896.
35.	A. L. Quaintance.....	Insects Injurious to Grain.....	October, 1896.
37.	O. Clute, W. A. Marsh.....	Pineapple	November, 1896.
38.	F. B. Moodie.....	Tobacco in Florida.....	January, 1897.
39.	S. Powers.....	Strawberries	July, 1897.
40.	A. L. Quaintance.....	The Fall Army Worm.....	July, 1897.
41.	P. H. Rolfs.....	The San Jose Scale.....	August, 1897.
42.	A. L. Quaintance.....	Some Strawberry Insects.....	August, 1897.
43.	A. A. Persons.....	A Chemical Study of Some Typical Florida Soils.....	September, 1897.
45.	A. L. Quaintance.....	Injurious Insects.....	March, 1898.
46.	A. L. Quaintance.....	Insect Enemies of the Tobacco in Florida	October, 1898.
51.	H. A. Gossard.....	Some Common Florida Scales.....	January, 1900.
52.	H. K. Miller.....	Baking Powders.....	February, 1900.
53.	H. Harold Hume.....	Some Citrus Troubles.....	March, 1900.
55.	H. E. Stocbridge.....	Feeding With Florida Feed Stuffs	September, 1900.
56.	H. A. Gossard.....	The Cottony Cushion Scale.....	May, 1901.
57.	H. Harold Hume.....	Top-working of Pecans.....	June, 1901.
58.	H. Harold Hume.....	Pomelos	July, 1901.
59.	H. Harold Hume.....	Cauliflower	October, 1901.
60.	H. K. Miller.....	Velvet Beans.....	January, 1902.
61.	H. A. Gossard.....	Two Peach Scales.....	July, 1902.
62.	H. Harold Hume.....	The Peen-to Peach Group.....	July, 1902.
63.	H. Harold Hume.....	Packing Citrus Fruits.....	September, 1902.
64.	C. F. Dawson.....	Texas Cattle Fever and Salt Lick	October, 1902.
65.	H. Harold Hume.....	The Kumquats.....	December, 1902.
66.	H. Harold Hume.....	The Mandarin Orange Group.....	February, 1903.
68.	H. K. Miller, H. H. Hume.....	Pineapple Culture, I—Soils.....	June, 1903.
70.	H. H. Hume, H. K. Miller.....	Pineapple Culture, II—Varieties.....	February, 1904.
71.	H. H. Hume, F. C. Reimer.....	Japanese Persimmons.....	March, 1904.
72.	C. M. Conner.....	Feeding Horses and Mules on Home-grown Feeding Stuffs.....	June, 1904.
73.	F. C. Reimer.....	The Honey Peach Group.....	July, 1904.
74.	H. Harold Hume.....	Anthraxnose of the Pomelo.....	August, 1904.
75.	H. Harold Hume.....	Potato Diseases	August, 1904.
76.	H. A. Gossard, H. H. Hume.....	Insecticides and Fungicides.....	November, 1904.
77.	C. F. Dawson.....	Equine Glanders and Its Eradication	February, 1905.
78.	C. M. Conner.....	Forage Crops. The Silo.....	March, 1905.
79.	H. A. Gossard.....	Insects of the Pecan.....	April, 1905.
80.	A. W. Blair.....	The Composition of Some of the Concentrated Feeding-stuffs on Sale in Florida.....	April, 1905.
81.	E. R. Flint.....	Fertilizer Suggestions.....	August, 1905.

Press Bulletins.

NO.	AUTHOR	TITLE	DATE
No. 1.	H. Harold Hume.....	Directions for Preparation of Bordeaux Mixture.....	February 1, 1901.
No. 2.	H. K. Miller.....	Lime and Its Relation to Agriculture.....	March 1, 1901.
No. 3.	H. Harold Hume.....	Seed Testing.....	April 1, 1901.
No. 4.	H. A. Gossard.....	The White Fly.....	May 1, 1901.
No. 6.	H. A. Gossard.....	Nursery Inspection (part 1).....	August 15, 1901.
No. 7.	H. A. Gossard.....	Nursery Inspection (part 2).....	September 1, 1901.
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No. 17.	A. W. Blair.....	Preservatives in Canned Goods.....	February 1, 1902.
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No. 22.	H. K. Miller.....	Nitrogen as a Fertilizer.....	April 15, 1902.
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No. 30.	C. F. Dawson.....	Dehorning Cattle.....	October 1, 1902.
No. 31.	A. W. Blair.....	Food Adulteration; Coffee.....	November 1, 1902.
No. 32.	C. F. Dawson.....	Foot and Mouth Disease.....	December 1, 1902.
No. 33.	H. A. Gossard.....	The Red Soldier Bug or Cotton Stainer.....	January 1, 1903.
No. 34.	C. F. Dawson.....	Ox Warbles.....	February 1, 1903.
No. 35.	A. W. Blair.....	Food Adulteration; Butter.....	March 1, 1903.
No. 36.	C. F. Dawson.....	Hook Worms in Cattle.....	April 1, 1903.
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No. 39.	C. F. Dawson.....	Lung Worms in Swine.....	July 1, 1903.
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No. 42.	A. W. Blair.....	Food Adulteration; Spices and Condiments.....	November 1, 1903.
No. 43.	C. M. Conner.....	How to Feed a Horse.....	December 1, 1903.
No. 44.	F. C. Reimer.....	Planting Trees.....	December 1, 1903.
No. 45.	H. A. Gossard.....	The Sugar Cane Borer.....	December 15, 1903.
No. 46.	C. M. Conner.....	Selecting Seed Corn.....	February 1, 1904.
No. 47.	C. F. Dawson.....	The Rabid Dog.....	March 1, 1904.
No. 48.	A. W. Blair.....	Food Adulteration; Adulterated Drugs and Chemicals.....	April 1, 1904.
No. 49.	H. K. Miller.....	Saw Palmetto Ashes.....	May 1, 1904.
No. 50.	C. F. Dawson.....	Insect Pests to Live Stock.....	June 1, 1904.
No. 51.	C. F. Dawson.....	Wormy Fowls.....	August 15, 1904.
No. 52.	E. R. Flint.....	The Loss of Nitrogen on the Farm.....	December 1, 1904.
No. 53.	C. F. Dawson.....	Hog Cholera and Swine Plague.....	December 15, 1904.
No. 54.	F. M. Rolfs.....	Seed Potatoes.....	December 15, 1904.
No. 55.	F. M. Rolfs.....	Potato Blight and Its Remedy.....	February 7, 1905.
No. 56.	E. H. Sellards.....	White Fly Conditions in Northern Florida.....	February 28, 1905.
No. 57.	E. R. Flint.....	Proposed Experiments on Fertilization of the Orange.....	September 11, 1905.
No. 58.	C. F. Dawson.....	Forage Poisoning.....	October 1, 1905.



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SECOND REPORT ON PECAN CULTURE.

In August, 1900, a preliminary report (Bul. No. 54) was issued from this Station on pecan culture. Subsequently, in June, 1901, a publication was made on Top-Working Pecans (Bul. No. 57). The editions of both these publications are now exhausted, and it has been deemed advisable to issue another bulletin on the same subject.

Since the first bulletin was brought out, the pecan has been carefully studied by the author, both in Florida and in other States. We have witnessed a steady growth in the interest taken in this valuable nut. During the period intervening since 1900 much that is new and noteworthy in pecan culture has been brought forward. Large plantings have been made in Western Florida, and in Alachua County in particular, as well as in other parts of the State. The culture of the pecan has not yet passed out from the formative period, and doubtless many mistakes have been made; but the fact remains that the pecan is a valuable nut-bearing tree, a valuable shade tree, and is worthy of the serious attention of every tree planter in the middle, northern and western parts of the State. A few of them should be planted by every farmer for shade and fruit. In the towns and villages it has its place as a street shade tree, and as an addition to the trees planted in town lots. As an orchard tree the pecan has much to recommend it, but serious attention must be given to the selection of the soil, location and varieties, and as good care must be given to it as to any other fruit tree. The rule should be to plant only as many trees as can be well cared for, and give them the attention they should have.

A large number of new varieties have been brought forward. Many of these are known only locally, and considerable time must elapse before their exact merits and adaptations are known. Many of them are very promising, but what they will do in new localities can only be determined by actual test. On the other hand, some varieties for one reason or another have proved themselves dismal failures in general culture. To such an extent is this true that many nurserymen have discontinued their propagation. But in these things the history of pecan varieties is the history of all other varieties of fruit. Many brought

forward and named, propagated and planted, only to disappear from the lists of standard varieties in a few years. It takes time to establish the merits or the weak points of a variety.

There is no question but that the time will come when the pecan will fill an important place in the rural wealth of the Southern States. We annually import something over \$5,000,000 worth of nuts; we export only about \$30,000 worth. Our exports will increase from year to year, and when they have reached any considerable amount it will be found that the pecan holds first place among the tree nuts exported.

The amount of pecans annually consumed in the country has been steadily increasing from year to year, and there has at the same time been a steady increase in the market value of the nuts. Nuts of very ordinary grade, such as are commonly used by nurserymen for raising stocks for nursery work, could be bought five or six years ago at from four to six cents per pound; now they are worth from eight to twelve cents. There has been, as well, a corresponding increase in the value of the product marketed for culinary and dessert purposes. The better grade of nuts, those which are sold by growers at from twenty to fifty cents, are taken entirely by a private trade, and the demand cannot be supplied, and there appears to be no immediate prospect of its being met, because the increasing demand is more than keeping pace with increased production. The pecan is destined to take the lead among tree nuts used in this country, and in fact among all fruits classed as nuts, the peanut excepted.

PECAN BOTANY.

The pecan tree is indigenous in the United States in the rich, alluvial bottoms of the Mississippi. Its northern limit is about Davenport, Iowa. In the Mississippi Valley proper it extends to within about seventy-five miles of the Gulf of Mexico. This was its southern limit in that region, though farther west it extends into Mexico.

The area as given in "Nut Culture in the United States" embraces an obliquely set area, having near its four extremities the cities of Davenport, Iowa, Chattanooga, Tenn., Laredo, Tex., and the region of the headwaters of the Colorado River in Texas. It extends farthest from the center of this area along the streams and rivers.



FIG. 1—Staminate Flowers of the Pecan.

Consequently it will be seen that the pecan tree is native in parts of the following States: Illinois, Indiana, Iowa, Missouri, Tennessee, Kentucky, Alabama, Louisiana, Arkansas, New Mexico and Indian Territory. Outside of this area it has been planted in a large number of States. Its cultivated area corresponds rather closely with that of the cotton plant, though it extends beyond its area.

The pecan belongs to the family *Juglandaceae* (Walnut family), its near relatives being the other species of hickory, the walnuts and butternut: For many years the scientific name commonly applied to it was *Carya*

olivaeformis Nutt, but in deference to the rules of priority this name has largely given place to the name *Hicoria pecan* (Marsh) Britton. This name, *Hicoria pecan*, is peculiarly significant, since it is truly American, being derived from *powc-hiccora* and

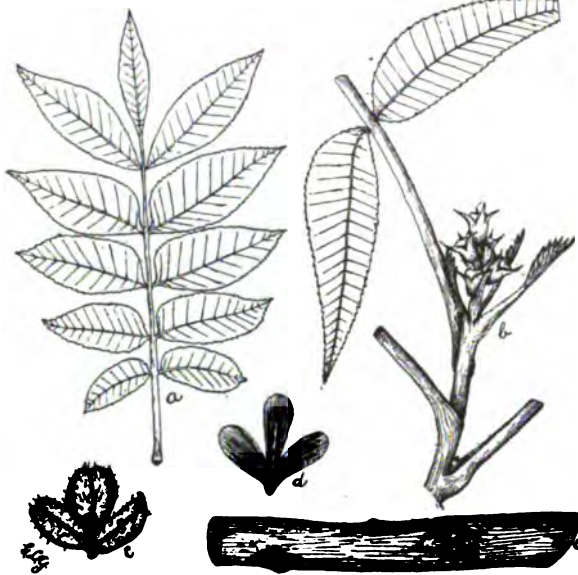


FIG. 2—(a) Leaf of Atlanta Pecan. (b) Twig bearing pistillate flowers. (c) Stamens. (d) Bract on which stamens are borne. (e) Portion of twig showing bud from which the staminate flowers are produced.

pecan, two words used by the Indians for hickory nuts.

It is a large, stately tree, 75 to 170 feet in height, with wide, spreading branches and symmetrical top. The bark is rough, broken and grayish black in color. The bark of the young twigs is quite smooth, liberally dotted with lenticels, and during their early life, together with the leaves and flowers of the tree, they are covered with a liberal coating of rather rust-colored hairs. The leaves are oval, compound, composed of from seven to fifteen falcate, oblong-lanceolate, sharp-pointed, serrated leaflets, green and quite bright above, lighter colored below, and when mature, nearly or quite smooth. The flowers are of two kinds—pistillate and staminate. The former are produced upon the young shoots, while the latter come from buds upon twigs one year old. The staminate catkins are usually produced in two groups of three each, from a single bud, and have very short stalks. The stamens are three to five in number in each flower, and borne beneath a three-parted bract. The pistillate flowers have a four-valved involucre (known in the mature form as the husk) and a two-parted stigma. The nuts are quite variable in size, shape, color and quality. Some are long and pointed, others are nearly spherical. In Texas, the spherical or nearly spherical nuts appear to be more common than elsewhere. Selected nuts of some varieties will weigh an ounce or more each, while of many other kinds it takes a hundred, more or less, to make a pound.

As a general rule, the husks of most varieties open at maturity. In some, however, they remain closed or nearly so. These latter varieties are objectionable on account of the increased difficulty of gathering the crop.

POLLINATION.—The pecan is wind pollinated. In consequence there is a great waste of pollen to compensate for which it is produced in large quantities. Wet, windy weather at the time the trees are in bloom, frequently interferes with pollination to such an extent that the crop is reduced very considerably.

With some species of hickory, notably *H. minima* and *H. glabra*, cross-pollination and consequent cross-fertilization with the pecan have resulted in several well-marked hybrids. None of those found thus far, with perhaps one or two exceptions, have been worthy of propagation.

Cross-pollination by hand for the production of better varieties, has been attempted, but as yet the work has not progressed far enough for the results to be known. This field is a very inviting one. The results from such work will certainly be as interesting and valuable as those obtained by breeding any other kinds of fruit. The chief objection is that considerable time must necessarily elapse—six years or more—before the results can be known, as it would take that length of time to secure nuts from the seed produced as the result of the crossing work. The operation of cross-pollenating the blossoms, as compared with other fruits, is comparatively simple. The rather tedious operation of emasculation, i. e., removing the stamens from the blossoms, is unnecessary as the stamens and pistils are produced apart from each other. All that is necessary is to cover up the pistillate flowers with a sack (to prevent any possible foreign pollination) until the pistils have matured. Then pollenate with the pollen desired and replace the sacks until the fruit has set. The paper sacks should then be taken off and the young fruit enclosed in a mosquito net sack until matured. Buds or grafts should be taken from the seedlings grown from these nuts and inserted in the tops of old trees. By so doing fruit can be secured much sooner than otherwise would be the case.

In Florida, the work of producing new varieties of known parentage is being systematically taken up by the Summit Nurseries, Monticello, Fla.

RANGE OF CULTURE IN FLORIDA.

The pecan may be grown in middle, northern and western Florida wherever the soil conditions are found to be satisfactory. Its culture should not be attempted in the southern portion of the State. Other trees can be grown there to much better advantage, and at any rate the success which would follow the effort is at least open to question. It can probably be grown farther south on the west than on the east coast, but generally speaking the attempt should not be made much south of the latitude of Lakeland on either side of the State.

The statement is frequently made that the pecan will succeed wherever the larger species of hickory are found in the

State. This is largely true, as the pecan belongs to the same family and genus of trees, but it should not, perhaps, be relied on too implicitly. At all events soil conditions must not be disregarded.

PECAN PROPAGATION.

The pecan may be propagated from seed or by budding and grafting.

Formerly they were grown almost entirely from seed and seedling trees were planted. But now seedlings have given way to budded and grafted trees. Why so? It was announced as a fact not so many years ago, and there are some who may still maintain it, that fifty per cent. or some other per cent. of pecans would come true to seed. But it must be stated as a fact that neither fifty nor any other per cent. will come true to seed. We have yet to find a single instance where the nut of

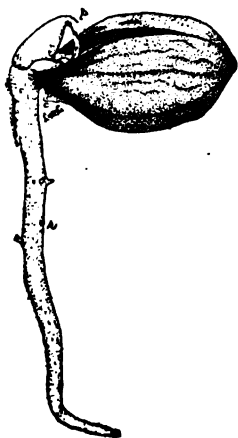


FIG. 8—(p) Germination of Pecan. (c) Cotyledons (r) Tap-root.

a seedling tree was identical with that borne by its parent plant. Occasionally they are better, but the rule is that they generally are vastly inferior to the fruit produced by the parent tree. Hence if an orchard of trees of the same habit of growth, prolificness, regularity in bearing, uniform throughout, trees which will produce a crop of nuts, uniform in size, shape, color and quality, is desired, do not plant seedling trees. Scores of these seedling trees produce nuts but little larger than chinquapins, and it is a fact which cannot be gainsaid that the seedling pecan up to the time of fruiting is an unknown quantity, after which it is too frequently a disappointment.

But seeds have their place. From them are grown the stocks upon which to work desirable varieties. From seeds may be originated new and desirable varieties, for it sometimes happens that the seedling is better than the parent. Seedling trees may be grown and set out in orchard form to be top-worked afterwards. This plan has something to recommend it. It is

less expensive, provided time is not an object, for it takes a longer time to get bearing trees by this plan, and it is open to the further objection that it is more difficult to secure uniformity in size and shape of tree than it is by setting out budded or grafted trees at first. The objections in the way of expense, if that be an objection, is best overcome by planting nuts in nursery rows, grafting the trees there, and then setting them in the field. By no means should the nuts be planted where the trees are to remain. It is too difficult to give them the necessary care. Besides, they are likely to be destroyed by squirrels or other animals, or the seedlings injured through carelessness in cultivation.

SELECTING AND PLANTING NUTS.—

Nuts to be used in growing stocks should be fully matured before gathering. Some care should be taken in their selection. They should be of good size for the variety, and should be gathered only from healthy, vigorous trees. Frequently the only object held in view is to get as many nuts as possible in a pound without regard to the tree on which they grew. We believe that this is in a large degree responsible for the unsatisfactory growth made by many grafted trees. Those nuts which mature first are best for planting.

The nuts may be planted in Florida as soon as they are taken from the trees, placing them in drills three and a half feet apart and covering them two and a half or three inches deep. In many cases it may be necessary and more convenient to stratify the nuts in damp sand in boxes, first an inch layer of sand, then a

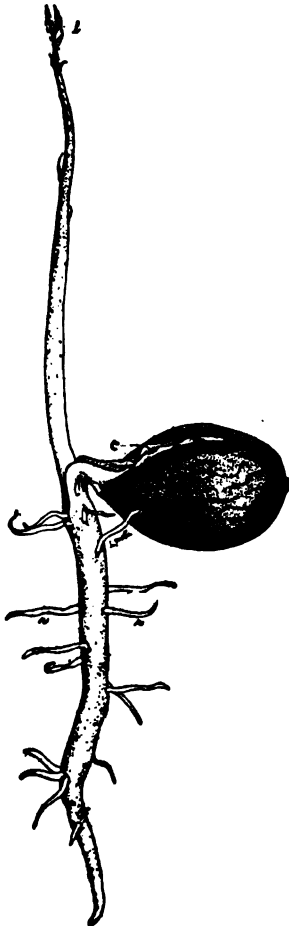


FIG. 4—Germination of Pecan.
(c) Cotyledons. (l) Leaves.
(r) Rootlets.

layer of nuts until the boxes are filled. These boxes should be placed in a cool, shady place, under a building, in a cellar or buried in the earth. It is a good plan to cover them with wire net to prevent mice, rats or squirrels from attacking them. In early spring the boxes should be emptied out and the nuts planted as directed above.

The seed-bed should be thoroughly prepared, plowed deeply or subsoiled, well supplied with organic matter, either from stable manure or from beggar weed, velvet beans or some other leguminous crop grown on the soil, and turned under.

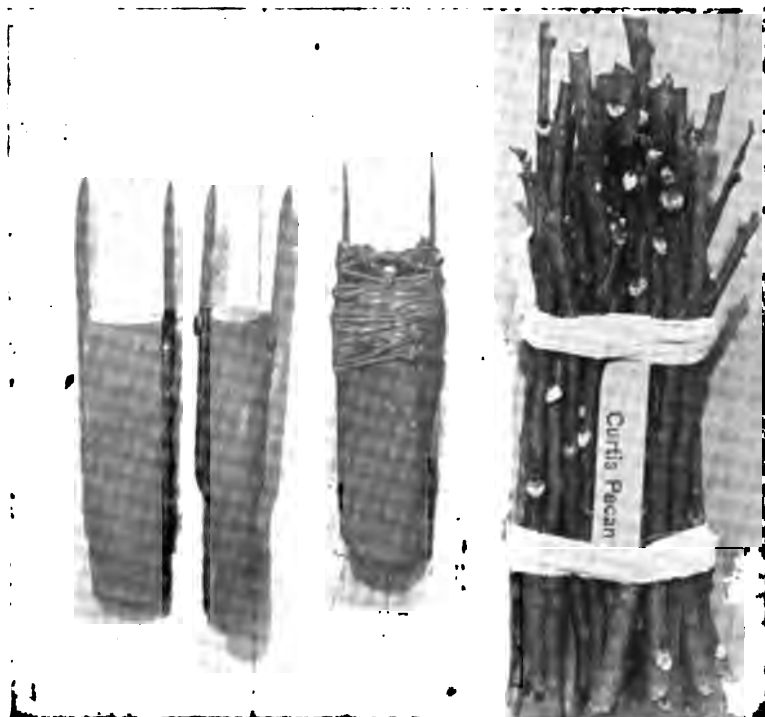
During the growing season the seed-bed should be kept well cultivated and free from weeds and grass. A fertilizer rich in nitrogen should be used. Its composition will have to be governed very largely by the character of the soil and the care and cultivation given it previously; but for good nursery soils a fertilizer analysing three per cent. phosphoric acid, three per cent. potash and five per cent. nitrogen will give good results. In a favorable season the tops of the young trees will be a foot or somewhat more in height with a tap-root two feet and a half or so in length. The following spring and summer many of the young trees can be worked by grafting or budding.

PROPAGATING TOOLS.—The tools necessary for propagating pecans—nursery work and top-working—are a common budding knife, a budding tool, a grafting iron, a grafting mallet and a fine-toothed saw.

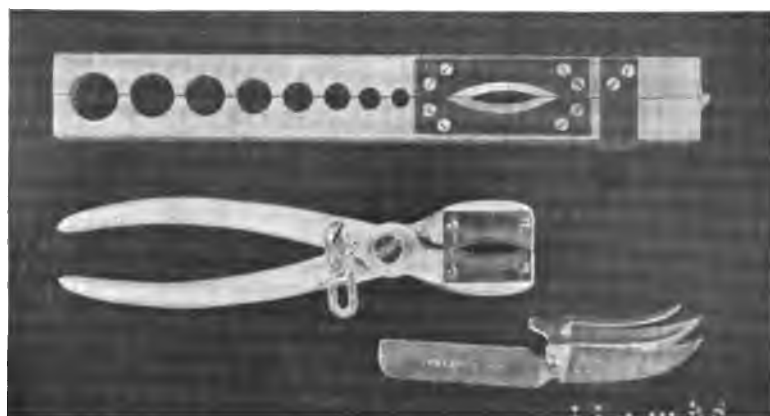
The budding knife should have a thin blade of good steel, capable of retaining a keen, sharp edge. The whetstone must be used frequently to keep the blade sharp to insure the making of smooth, clean cuts.

At least three budding tools have been invented. These, shown in the accompanying illustration, are known as White's, Galbreath's and Nelson's budding tools respectively. The principle in each one is that two sharp cutting blades are fixed parallel to each other to insure uniformity in cutting annular and veneer-shield or patch buds. White's budding implement is especially recommended for use in top-working. The holes along the sides are used as a gauge for measuring the stock and bud stick. In the writer's opinion Nelson's instrument is the one

PLATE I



Three Budding Knives made and used by Dr. J. B. Curtis, Orange Heights, Fla., and a bundle of Clons tied up ready for shipment.



Budding Tools—White, Galbreath and Nelson in the order named.

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best adapted for veneer-shield budding, but the blades are just a little too close together. A very satisfactory knife for this work may be made from two ordinary budding knives and a piece of wood three-quarters of an inch square and four inches long. To opposite sides of this the blades can be firmly attached with rivets and by binding with fine wire and twine.

The grafting iron is indispensable in cleft-grafting. These can be purchased at small cost or a blacksmith can make an excellent one from an old flat file. Three or four inches of the file should be flattened and sharpened for a blade. In the remainder drill two holes and attach two pieces of wood to form a handle.

A small sized carpenter's mallet answers nicely for a grafting mallet, or a very good one may be made from a piece of tough wood or a piece of an old wagon spoke. A leather thong should be attached to the handle through which the wrist can be slipped to carry it when top-working.

The best saw for use in top-working is a carpenter's back saw. This has a stiff blade, fine teeth, and leaves a smooth, clean cut.

WAXES, CLOTH AND TWINE.—Good grafting wax may be made according to either of the following formulas:

1. Resin 6 pounds, beeswax 2 pounds, linseed oil 1 pint.
2. Resin 4 pounds, beeswax 2 pounds, tallow 1 pound.

Melt the ingredients in an iron kettle over a slow fire, stirring slowly to insure thorough mixing. When melted pour out into a bucket of cold water. Grease the hands, remove the wax from the water as soon as it can be handled and pull until it is light yellow in color. Wax not needed for immediate use may be rolled up in balls, wrapped in oiled, stiff, brown paper and put away for future use.

Waxed cloth can be prepared by melting the wax in a kettle and dropping into it sheets or wide strips of old calico or cotton cloth. As soon as saturated with the wax, remove them from the kettle and stretch on a board. For use tear into strips, one-quarter or one-half of an inch wide.

Waxed twine is prepared by dropping balls of No. 18 knitting cotton into the melted wax and stirring them about for four or five minutes or until the wax has penetrated them.

SELECTING CIONS AND BUDS.—Cions and bud sticks should be taken from healthy, vigorous trees. Select the cions from well matured wood of one year's growth, though a piece of two-years old wood at the base will not matter. Fig. 5, No. 1, shows an undesirable cion. The wood is angular, small and the internodes long, and the pith large in proportion to the diameter. Either terminal portions of twigs may be used or portions back of the tip, but the buds should always be well developed, full and plump. For this reason grafts should not be cut from wood far back from the tip of the branch. As stated already, twigs of the previous season's growth are generally used, provided the growth is not too large. Fig. 5, No. 8, shows one of these. Grafts are generally cut about five or six inches long and should

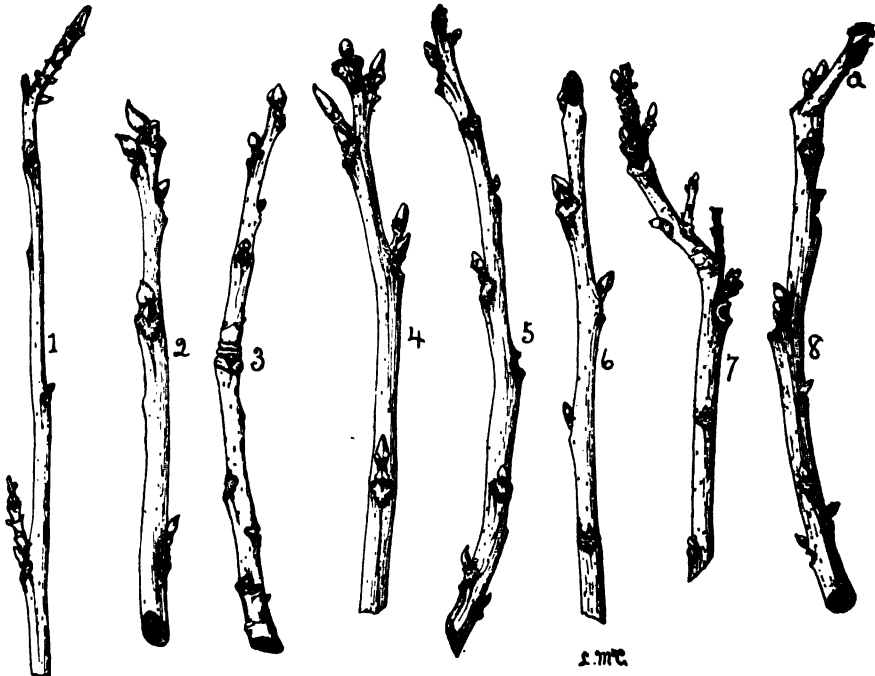


FIG. 5—Cions. 1-8 Curtis; 4-6 Van Deman; 7-8 Stewart. 1, poor Cion; long, slender, pithy; 2-4-5-7-8, Cions from 1 yr. growth; 8, Cion partly one, partly two years old; 8, Cion with cut, back of tip; 8; Cion which bore fruit at a.

be from one-quarter to three-eighths of an inch in thickness.

It is best that the grafts be cut while still in a dormant state, and inserted in the stock just before growth starts. The cions

may be kept for a considerable length of time by placing them, loosely packed, in damp moss or sawdust, in a box. The box should be covered over with earth and the cions kept sufficiently moist to prevent drying out. The difference in the condition of the stock and cion, it should be understood, is not absolutely necessary, as good results are frequently obtained without these precautions, but in grafting the pecan a difference in dormancy is extremely desirable, and is an important factor in securing good results.

For bud sticks, well developed one-year-old branches, one-half to seven-eighths of an inch in diameter and on which the buds are well formed, or older wood with plump, full buds are selected. Such sticks frequently show three buds at a node (Fig. 10), and if some misfortune should overtake one or two of these, there is still a chance of success, though the upper one being the strongest is generally the one which starts, provided it is uninjured and the bud takes. The degree of maturity of the bud is important and care should be exercised that only those which are plump, full and well developed, are used. It is easy to distinguish between desirable and undesirable buds.

GRAFTING AND GRAFTING METHODS.

Top-working by grafting or the grafting of nursery stock above ground should be done in spring just before growth starts. The preference is for the latter part of the season, provided there is not too much work to be done, as the cions have less time to dry out before the process of uniting with the stock begins. The work of whip-grafting nursery stock under ground just at the crown roots of the seedlings can be started in the latter part of December and continued until February. For this work, the earth is thrown back from the seedlings, leaving them standing in a narrow trench. After the cions are inserted, the ground is placed back about them, covering them up, leaving only the top bud exposed. The seedling trees cannot be dug up and bench-grafted satisfactorily in winter, as is the practice with apples, pears and other fruits. It can be done, but the percentage of unions secured is too small to make it an economical method to follow. The only satisfactory plan is to graft the seedlings in the nursery row, as described above.

Two methods of grafting are used, cleft-grafting for top-working and whip-grafting for working both nursery seedlings and old trees.

CLEFT-GRAFTING.—Having selected the place on the branch or trunk at which the cion or cions are to be inserted, the part should be sawed off with a smooth, clean cut. If a large branch is to be removed, it should be done after the manner illustrated in Fig. 12, making the cuts in the order numbered to prevent splitting. The end of the stub can then be cut squarely off at the point desired.



FIG. 6—Cleft-grafting. 1. Cion. 2. Cion inserted ready for tying. 3. Stock, showing cleft.

The trunk or branch is then split with the grafting iron as shown in Fig. 8. The cleft should be carefully made and should be about one and a half inches in length. In preparing the cion, a sloping cut is made at the lower end about one and a half inches long, cutting into the pith from a point one-half way up the cut, down to the lower end. On the opposite side, the second cut should not touch the pith, but should be made through the wood throughout. The cion should be left wider on the outer side than on the inner to make a tight fit when inserted. Start the cuts

on each side of and just at a bud. Fig. 6.

Having made the cleft, open it with the wedge end of the grafting iron and place the cion in position in the cleft stock. *The cambium layers should be in contact* and the cion should be shoved well down until the whole of the wedge is within the stock. In large stocks two cions may be inserted, the weaker of which should be removed if both live. Large stocks will exert sufficient pressure against the cions to render tying unnecessary,



FIG. 7—Whip-grafting. 1. Stock prepared. 2. Cion prepared. 3. Stock and cion together ready for wrapping.

but if the stocks are small the union should be firmly tied with waxed twine or cloth and in any case the ends of the cut stock and the union must be covered smoothly with grafting wax. Should



FIG. 8—Grafting Iron used for Cleft-grafting.

there be danger of the stock exerting too much pressure (as in the case of large stocks) the cleft should be made well out to one side of the center.

WHIP-GRAFTING.—Stocks, whether seedling trees or branches in the tops of old trees, should be less than an inch in diameter, one-half or five-eighths inch being a nice size.

A sloping cut, an inch or an inch and a half long is made at the end of the scion, a corresponding cut is made on the stock. A small tongue of wood is raised on each by making a cut with the knife blade parallel to the grain of the wood. The tongue is raised a little on both stock and cion and the two are then shoved together, with the cambium layers on one or both sides in contact. They must then be firmly bound either with twine or cloth, the whole of the cut surfaces being covered over to the exclusion of water, air, and the germs of decay.

The cion and stock are preferably chosen of nearly the same size but a cion somewhat smaller than the stock may be used, in which case the cambium layers along one side of the surfaces in contact must be placed opposite as already indicated. In working nursery seedlings by whip-grafting, the cions should be inserted

so that the point of union will be under the surface of the ground. The earth should be placed back around the union as soon as the



FIG. 9—Whip-grafting at the crown in the nursery row. The earth has been thrown back; the stocks are cut in front of the workman; the man in the distance is filling up the trench.

work is completed. This plan of propagation will not give satisfactory results except on well drained lands.

BUDDING AND BUDDING METHODS.

Budding is preferred to grafting by some propagators, as they are able to secure a larger percentage of unions than by grafting; others prefer grafting. Much, however, depends upon the locality, soil and drainage. By either method from fifty to seventy-five per cent. of successful unions must be considered satisfactory. The amateur may well be satisfied with ten per cent.

The season for budding is when the bark will slip well during

the months of July and August. The season is, however, often extended into September. Many of the buds inserted late in the season remain dormant until the following spring.

During the season from the first of July until September, the atmosphere is moist, the buds are in good condition, the sap flows freely, and better results are secured than at any other time. The buds commonly used are those which have been formed just previously. They should be carefully selected and only those fully matured should be used. Oliver (Bulletin 30, Bureau Plant Industry, U. S. D. A.) recommends the use of dormant buds of last season, but the method has not met with favor because of the large amount of wood which must be sacrificed to secure a few buds.

ANNULAR BUDDING.—By this method branches or seedling trees three-quarters of an inch or less in diameter may be worked. It is preferable that the stock and bud stick be of the same size, though the stock may be somewhat smaller. From the stock remove a ring of bark an inch or so in length. On the bud stick, select a good, plump bud and remove it by taking out a ring of bark the same in size as the one removed from the stock. Place this ring in the place on the stock prepared for it

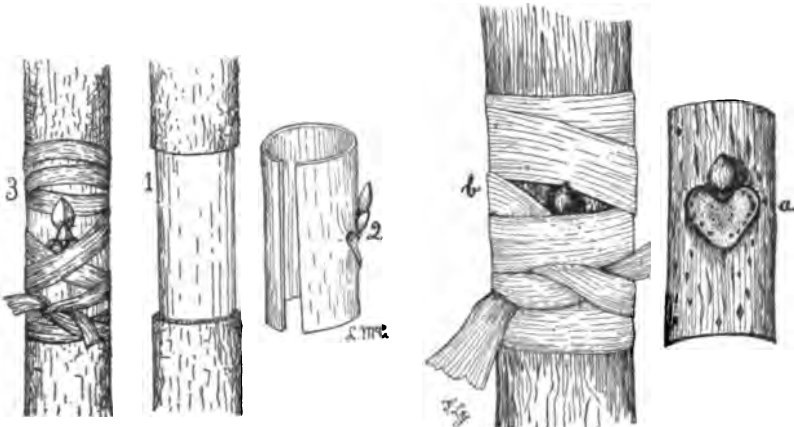


FIG. 10—Annular Budding. 1. Stock prepared for bud. 2. Bud. 3. Bud in place and tied.

FIG. 11—Veneer Shield-budding. (a) Bud cut. (b) Bud inserted and tied.

and bandage securely in place, using a piece of waxed cloth. The wrapping should be brought around the stock so as to

cover the cut ends. The bud may be covered over or left exposed.

In ten days or two weeks, remove the bandage, and examine the bud. A plump, full bud at this time is an indication that union has taken place.

VENEER-SHIELD OR PATCH BUDDING.—If this method is used, it is not essential that the stock and cion be of the same size and so far as size alone goes, almost any stock may be used. A rectangular, or triangular piece of bark is removed from the side of the stock. From the bud stick cut a similar piece of bark with a bud in its center. Place the bud in place on the stock and wrap as in annular budding. If the stock is considerably larger than the bud stick, the piece of bark with bud attached will have to be flattened out somewhat before inserting.

LOPPING.—Frequently buds, particularly those inserted late in the season, act as dormant buds and do not begin growth until the following spring. The top of stocks budded during June, July and August should be lopped, up to September first. It is always well to start the buds out before growth ceases for the season, but stocks budded after the first of September should not be lopped until the following spring, just before growth begins.

One method of lopping is to cut the stock back to within five or six inches of the buds, at first. Later, after the bud has grown to some size, it should be cut right back to the bud and painted over to prevent rotting. Lopping may also be performed by cutting the stock half off two or three inches above the bud and bending it over. After growth starts in the bud it should be removed entirely, thus throwing the full flow of sap into the bud.

THE NURSERY.

The best soil for the pecan nursery is a well-drained, loamy soil with a clay or sandy clay subsoil. The land should be put in good condition before the trees or nuts are planted in it. Crops of beggar-weed, velvet beans plowed under, or a good dressing of well-rotted stable manure will go a long way toward putting the ground in good shape. The ground should be plowed deeply and put in the very best tiith.

Throughout the growing season, the ground should be cultivated frequently. Shallow cultivation to conserve moisture and destroy weeds is all that is necessary. It is not possible to grow good trees without thorough, frequent cultivation.

Fertilizers containing considerable nitrogen should be used at the rate of about 300 pounds per acre. One analyzing 3 per cent. phosphoric acid, 3 per cent. potash and 6 per cent. nitrogen is about right for nurseries on most Florida soils.

As soon as a block of trees is removed it is an excellent plan to sow the ground in one of the leguminous crops mentioned above, to help it to recuperate. The frequent cultivations, so necessary for the growth of the trees, wear out the humus in the soil. The legumes will replace this if grown, and plowed back into the soil, after they are dead and dry.

TOP-WORKING PECAN TREES.

By far the greater number of seedling trees in the State have not fulfilled the expectations of their planters. The trees are not prolific or the fruit which they bear is small and inferior. Such trees if in good health and vigor may be top-worked to advantage. Seedlings may be planted with the expectation of top-working them, but this is not recommended.

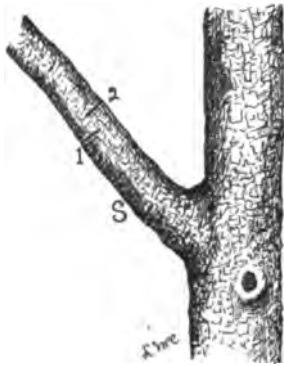


FIG. 12—Method of cutting large branches to prevent splitting.
1. First cut. 2. Second cut.
S. Stub.

If the trunks are small, an inch or an inch and a-half in diameter, the whole top may be removed at once. If the trees are of medium size, the main branches may be worked close to the trunk and if large, grafts may be inserted farther up from the trunk. Buds may be inserted in vigorous

branches. The growth of such branches may be induced by cutting back the original branch of the tree in late winter. Lateral buds will thus be forced into growth and by midsummer the branches formed from them will be large enough to bud. *The attempt should not be made to bud or graft over the whole top of a large tree in one season.* Only a few branches should be worked each year, and in the course of two, three or four years, depending upon the size of the tree, the old top can be

entirely removed and replaced by a new one of a good variety.

Both cleft- and whip-grafts may be used, but the latter can, of course, only be used on small stocks. The objection to working very large branches is that they do not heal readily; two and a-half inches is about the maximum in size. Large wounds should be painted over with white lead paint to prevent decay.

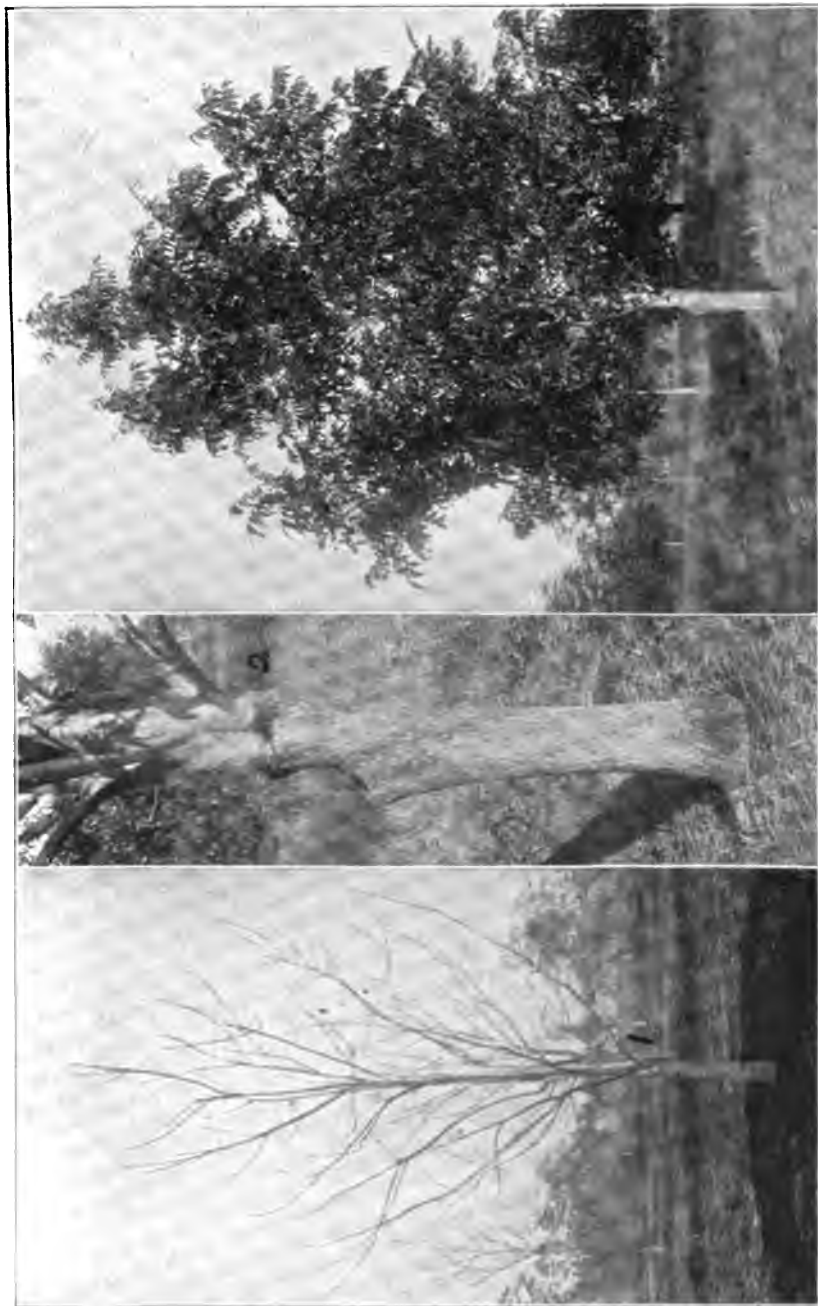
For several months after the new top has commenced to grow the cions or buds have but a slight hold upon the stock, and as the growth is usually very vigorous and the leaf surface great, considerable damage is frequently done by strong winds, or by wind and rain together. To prevent this the young shoots may be tied together or fastened to other portions of the stock. If this be done, care should be taken that the twine used does not do injury by cutting into the wood. To obviate this a piece of burlap should be placed around the branch beneath the twine and the twine should be removed as soon as it has served its purpose. In some cases the top may be supported by lashing a pole against the side of the trunk and fastening the grafts to the upper



FIG. 13—Two methods of preventing the splitting of crotched branches, by means of a bolt on the left and a living brace on the right.

part of this, or a pole may be driven into the ground at some distance from the trunk, fastened against a branch or stub of a branch above and used in the same way. After the top has grown sufficiently to take care of itself these posts can, of course, be removed. Sometimes, after the top has made considerable

PLATE II



Van Deman Pecan top-worked on a seedling tree. 1. Winter view. 2. Close view of union. 3. Tree in foliage. Some nuts were borne the second season.

PLATE III.



Top-worked trees. 1. Bad crotch formation. 2. Top supported by a post shown at the right. 3. Large tree grafted on the branches.

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growth, and particularly if large branches are allowed to develop opposite each other, they are split apart and the whole top ruined. If this undesirable conformation exists it is best to take steps to prevent splitting. A bolt having a stout washer against the head should be placed through two branches, a second washer placed on and the nut screwed up. This bolt will, in the course of a few years, be entirely covered. By this means the tree trunks are held firmly together. This same plan may be used to save branches which have partially split apart. Sometimes a branch may be inarched from one large branch to another to serve as a living brace.

Necessarily a considerable number of wounds are made in top-working. Branches are removed entirely, others are cut back to within a foot or so of the trunk and grafted. Often these fail to unite. Such stubs should not be left. If branches are formed on them they should be cut back to the point where these buds start; if no branches come out from them they should be cut back to the trunk or large branch on which they are borne. If left they prevent the healing of the wound, rot back, and the rot is carried into and down the trunk of the tree resulting in a hollow and weakened trunk. *Smooth cuts should be made and these should be covered with white lead paint to prevent decay.* A little lamp black may be added, if desired, to make the paint nearly the color of pecan bark.

SOILS AND THEIR PREPARATION.

The peculiar conditions of soil and moisture surrounding the pecan in its native home might be regarded as an indication that it could not be grown except on deep, rich soil, in proximity to rivers, ponds or streams. Such, however, would be a wrong inference, for it succeeds admirably and bears good crops on a wide range of soils. Hence, we find it today in localities far removed from the regions to which it is indigenous, and thriving under conditions differing greatly from those obtaining in its native home. In Florida trees may be found growing on soils ranging from the black hammock to the less fertile high-pine lands. On hammock soils, however, the trees are often inclined to develop wood at the expense of fruit, while on less fertile soils the trees make less wood and bear more fruit proportionately. Pecans thrive well on flat woods; the grove of Dr. J. B. Curtis,

Orange Heights, Fla., is planted on this type of land. Moisture in sufficient quantity must be present, but it will not do to plant the pecan on land that is continually wet and soggy. The presence of a hard, impenetrable subsoil doubtless has a great influence upon the welfare of the tree, and it would be better to select other ground, or when this is impossible, to blast out the hardpan. A quicksand subsoil is equally objectionable. If close to the surface, it should not be used. The roots cannot penetrate it. All things considered the best soil is probably one which has previously supported a growth of holly, willow-leaved oak, dog-wood, hickory and those other trees usually found associated with them. A sandy loam with a clay or sandy clay subsoil is difficult to surpass.

The land intended for young trees should be well prepared. This preparation will depend largely upon the care and treatment which the soil has received previously. Land on which the forest still stands should preferably be thoroughly cleared and put in cultivation for a year or two before planting. Leguminous crops are excellent to precede the setting of the trees. Plow the ground thoroughly, break deeply, harrow it level and it is ready for the trees.

PECAN PLANTING.

BUYING TREES.—Florida has suffered as much from fraudulent pecan tree agents as any other State. Seedling trees have been "doctored" and sold to planters and varieties have been sold which were untrue to name. Unfortunately too few people are acquainted with the characteristics of a budded or grafted tree.

Those who are thoroughly acquainted with the wood, twigs and branches of pecan trees are able to tell the different varieties at a glance. The color of the bark, the shape, size and arrangement of the lenticles, the size and shape of the buds are always characteristic and by these marks varieties can be distinguished. Every planter should acquaint himself with the wood characteristics of the varieties. But after all, the safest, by far the safest plan is to deal directly with honest nurserymen, men of unquestionable integrity, men who give their business careful thought and attention.

The best trees for general planting are well grown one-year-old trees, from three to five feet high.

Too often but slight attention is given to the planting of the trees. There is too frequently a disposition on the part of the person setting trees of any kind to do the work as rapidly as possible without consideration for the future welfare of the plants. Few realize that time spent in careful, intelligent preparation of the soil and in setting the trees is time well spent, and well paid for in the after development of trunk and branch. Better a month spent in preparing the future home of the young tree than years of its life spent in an unequal struggle for existence. More than that, the tree may die out-right and a year must elapse before it can be replaced. It is generally stated that the pecan is a slow grower, and yet trees from twelve to fourteen years old will sometimes measure from thirty-five to fifty-seven inches in circumference at the base, while under less favorable circumstances others will stand still for a period of six or seven years, or until they have accumulated sufficient energy to overcome the untoward conditions of their environment.

DISTANCES.—The distance apart at which the trees should be set, will depend in a measure upon the character of the soil. If rich and moist the trees should be set farther apart than on higher, drier soils. Forty feet is generally believed to be about right for most Florida lands. Two methods of setting may be followed, rectangular and hexagonal. The number of trees which may be set per acre by the rectangular system are as follows:

40x40	27 trees
40x45	24 "
40x50	21 "
40x60	18 "
45x45	21 "
50x50	17 "
50x60	14 "
50x75	11 "
60x60	12 "
60x75	9 "
70x70	8 "
70x75	8 "
75x75	7 "

To find the number of trees for any distances not given in the above table, multiply the distances together and divide 43560,

the number of square feet in an acre, by the product. The result will give the number of trees.

By the hexagonal system about fifteen per cent. more trees may be set per acre than by the rectangular system. If a double planting is contemplated, as pecans and peaches, the rectangular system should be used and one or more peaches set out in each rectangle formed by the pecans.

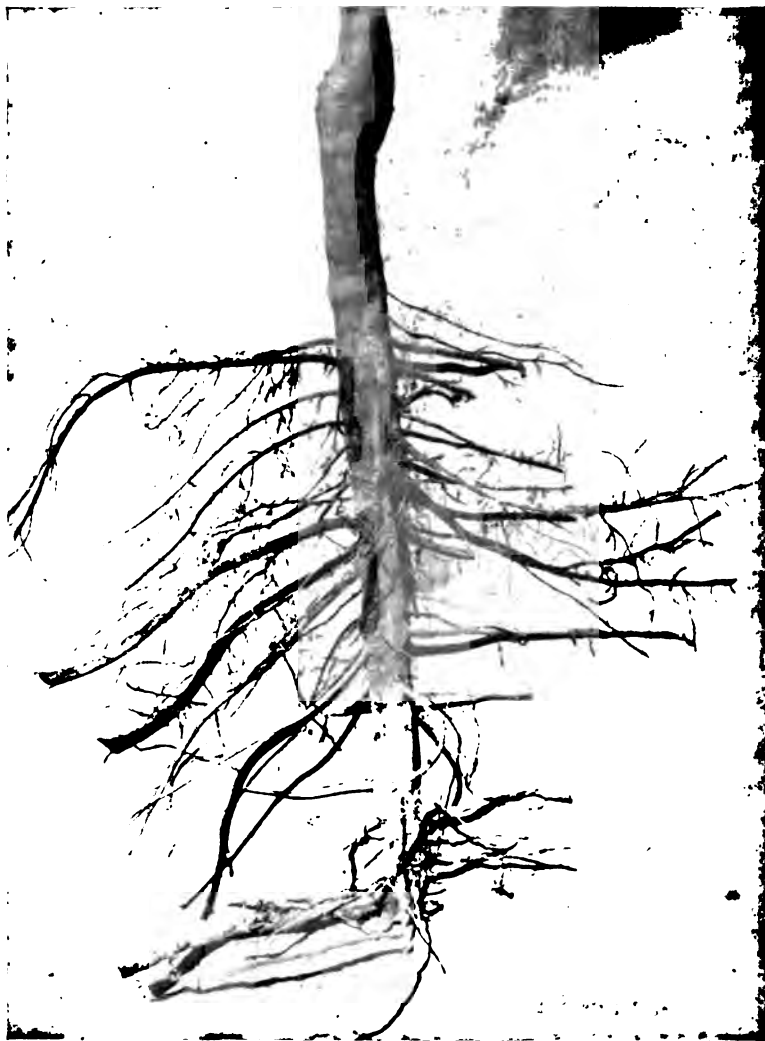
STAKING THE GROUND.—If a good plowman can be secured, the rows can be run off with a plow, running both lengthwise and crosswise of the field. Ordinarily, however, a true corner may be established with a carpenter's square, the field staked out around the outside. For the rectangular system, the stakes can then be set up in the center of the field by measuring, or by sighting, or by both. Ordinary building laths make good stakes.

To stake off the ground by the hexagonal method, commence on one side of the field and plant stakes at the desired distance apart where the trees are to stand. Using two chains or two pieces of wire with rings at the ends (their length being the same as the tree distance), the positions for the second row of trees may be easily ascertained. Drop the rings over two adjoining stakes and stretch them out until they form an equilateral triangle with the base line. Plant a stake at the apex to indicate where the tree is to stand. Set up all the stakes for this second row in the same manner, then use it as a base line and so on across the field.

PLANTING.—Having set a stake where each tree is to stand, the planting board should then be brought into use. This is simply a light board, five or six inches wide and six feet long, with a notch cut in the center of one side and an inch hole bored in each end. In digging the holes for the trees this board is laid down on the ground with the notch against the tree stake. Two small wooden stakes are then shoved into the ground through the holes in the ends and the board and tree stake both taken away.

Dig the holes broad enough and deep enough to accommodate the roots of the trees. Prune back the broken ends of the roots. The tap-roots should be left eighteen inches long on the smaller size of nursery trees, while on larger and older trees they should be left longer, twenty-four or thirty inches.

PLATE IV.



Root system of a well grown nursery tree.

4761

No injury will result from thus cutting the tap-root; a new one will be formed.

Having dug the hole, place the planting board back over the small stakes still left in the ground, set the tree with its trunk in the notch which will bring it just where the tree stake was and proceed to fill in the hole. Surface soil should be used for filling, and the ground carefully packed about the roots by hand. One pound of commercial fertilizer per tree may be used to advantage. This should be *thoroughly mixed* with the soil used in filling in the hole. When the work is finished, a surface mulch of leaves, straw or trash should be provided to prevent evaporation, or the ground may be raked on top to form a mulch of dry earth.

Never allow the roots of a pecan tree to become dried out. It is best that the necessary root-pruning be done in the shed and the trees carried to the field wrapped in a damp blanket, from which they are removed one by one as required for planting. The tops should be pruned back slightly to restore the balance between the roots and the tops which has been disturbed in the process of transplanting.

The best time to plant pecan trees is somewhere between the first of December or the latter part of November and the first of February. Preference must be given to the earlier part of this period as the ground will have a chance to become firmly packed and the root wounds will have partially callused over before the growing season begins. Besides, the early spring season in Florida is usually dry and recently planted trees do not stand nearly so good a show as those planted in December and January.

CULTIVATION.

Because the pecan grows as a forest tree in some parts of the country, many people suppose that it can be left without care and cultivation, left as any other tree in the fields and woods is left to shift for itself. But if fruit is required from the tree, no matter whether planted in the garden or the orchard, it should be given good care. Too many of our practices are based upon ideas taken from the native trees of the woods and fields. But all these trees do from year to year is bear a few fruits, many

of which are imperfect, in the attempt to reproduce themselves. If that is all that is desired of the pecan tree, well and good, a system of neglect will secure the result and the insects and fungi will be the chief beneficiaries of the practice.

One lesson can be learned from the woods. The ideal soil condition for the pecan grove is that found in the forest. The soil there is filled with vegetable matter, and humus; it holds water and plant food. The aim in the cultivation of the trees should be to provide and maintain a soil as nearly ideal as that.

Whether anyone would have the temerity to advocate the cultivation of a pecan orchard along the lines applied to peach orchards and citrus groves is seriously doubted. A pecan plantation will begin to bear in from six to eight years after planting and should produce a very fair crop at ten years, after which it rapidly increases in productivity. But during the period when the trees are growing and no fruit is being produced, cultivation must be given.

This is best done by planting the land between the tree rows in cotton, peanuts or other field crops, in vegetables, cowpeas, beggarweed or velvet beans. The last mentioned crops may be used in making hay. These are the ideal crops for the pecan orchard. It would be best to follow a systematic rotation of these crops. As for instance, 1st year peanuts, 2d year cotton, or 1st year crabgrass and beggarweed, 2nd year cotton, 3rd year velvet beans.

The area grown in these crops should by no means equal the total area of the field. The tree rows for a width of four or five feet on each side should not be planted in crops during the first year. This strip should, however, be cultivated during the first part of the season and about the beginning of the rainy season sowed to beggarweed. The cultivated area will necessarily become more restricted each year, and eventually the ground will have to be given up to the trees.

Then the plan frequently advised (and the author must plead guilty to having done so at one time himself) is to put the land in grass and use it as a pasture. But grass is generally an important item in the cultivation of neglected pecan orchards. *It is synonymous with neglect and bad treatment.* It interferes

with the growth, development and fruiting of the trees and this plan is no longer advised by the writer.

Instead, it is preferable to cultivate the trees in spring, continuing the cultivation well up to the rainy season. Later, in August, a crop of crabgrass and beggarweed may be removed for hay. By autumn a considerable additional growth will be formed to cover the ground in winter and turned back into the soil to restore and maintain the necessary humus content of the soil.

FERTILIZERS.

On nearly all Florida soils, pecan trees are benefited by the application of fertilizers in some form or other. Large quantities of food materials are taken from the soil in the growth of the tree and the development of the crop.

The greatest demand made on the soil by the tree is for nitrogen and this can be met by applying stable manure, or by growing leguminous crops and turning them under as already directed. In the fertilizing of the pecan this is by all means the best policy. The potash in the form of sulphate or muriate of potash and the phosphoric acid in the form of acid phosphate can be supplied separately.

FORMULAS.—The requirements of the trees will differ at different stages of their growth. The needs of the young trees differ from those of fruiting ones. For young trees, nitrogen in considerable amounts is required while for bearing trees, more potash and phosphoric acid and less nitrogen relatively are required. If complete fertilizers are used, those given the young trees should analyse about five per cent. phosphoric acid, six per cent. potash and four per cent. nitrogen; while one containing six per cent. phosphoric acid, eight per cent. potash and four per cent. nitrogen is about right for bearing trees.

If we assume that acid phosphate analyses 14 per cent. phosphoric acid, high grade sulphate of potash 50 per cent. potash, cotton-seed meal 6.5 per cent. nitrogen, and dried blood 14 per cent. nitrogen, the following amounts of these materials which may be mixed at home will give approximately the above analysis:

FOR YOUNG TREES:—

Acid Phosphate (14 per cent. goods).....	700 pounds
H. G. Sulphate Potash.....	225 "
Cotton-Seed Meal.....	1150 "

If dried blood is used in place of cotton-seed meal one-half the amount or 575 pounds will give as much, or slightly more, nitrogen than the 1150 pounds of cotton-seed meal.

FOR OLD TREES:—

Acid Phosphate (14 per cent.).....	850 pounds
H. G. Sulphate Potash.....	300 "
Dried Blood.....	250 "
Cotton-Seed Meal.....	600 "

2000 pounds

APPLYING THE FERTILIZER.—The whole of the fertilizer may be applied in spring just before the growth starts. On the whole this is one of the best times to apply it. In some cases it may be advisable to apply only half the material at that time, leaving the other half for application about the first of June. So far as the nitrogen part of the fertilizer is concerned, this would be good practice, but the potash and phosphoric acid may as well be applied at the beginning of the season's growth.

In applying the fertilizer to young trees, it should be put on in a circular band about the tree (closer or farther away depending on the size of the tree) and spreading it around on a strip four or five feet wide. As the trees increase in size, the fertilizer should be applied over a larger area until, in the case of old trees, the whole surface should receive an application.

PRUNING.

For such pruning as is necessary for pecan trees a few tools should be provided. These will consist of a pair of good pruning shears, German solid steel pruning shears being the best, a pair of Walter's tree pruners for cutting back long branches, and a good pruning saw. One of the best pruning saws is what is known as a Climax pruning saw, or a Pacific Coast pruning saw is equally as good.

It is not advisable to prune the trees during the time when growth has just started in spring and the sap is in active motion. At this time it will be well nigh impossible to properly protect the wounds. The necessary coat of paint will not stick to the wound when wet with sap from the tree.



FIG. 14—Rotten hole due to careless pruning at the left. A properly made wound ready for painting is shown at the right.

While pruning may be done during the summer months when the tree is in full leaf, all things considered, the best time to prune is in early spring before growth starts. There is usually less to be done on the farm at this season, and more time is available for the work. Wounds made at this time usually heal quite rapidly.

In cutting all branches the saw should be held parallel to the part which is to remain, and the branch should be cut off smoothly, close up to the trunk.

As soon as the branch is removed the wound should be painted to protect it from decay. For a protective covering nothing is better than white lead paint. A small amount of coloring matter may be added to it, if desired.

As a general rule the pecan requires comparatively little pruning. At the time of planting the young trees should be cut back some distance, particularly if they are very tall. It is well to have the main branches form within four or five feet of the ground. After this about all the pruning necessary is to remove

dead or injured branches and cut back those which have a tendency to run up beyond their neighbors. For this work, as well as in procuring grafts or bud-wood from the top of the tree, the tree pruner comes into good service.

Top-worked trees frequently require considerable pruning to get them started so that they will develop into shapely, symmetrical trees. The accompanying illustration shows a young top-worked tree. Two cleft-grafts inserted in the main shoot of the top have made a splendid growth. Part of the old top still remains below. This should be removed and the grafts should be pruned as indicated by the lines. One of them should be removed entirely to do away with the undesirable crotch formation and almost certain consequent splitting of the top.

HARVESTING AND MARKETING.

The pecan crop is not so difficult to harvest and prepare for market as a crop of oranges or peaches, for instance, and yet some care must be taken to put the nuts on the market in inviting shape.

FIELD EQUIPMENT.—The equipment necessary for harvesting consists of an extension ladder, a step ladder, a number of bamboo fishing poles and picking sacks. The best kind of step ladder is one having three legs instead of four. Picking sacks may be made from ordinary hemp or jute sacks. The sack should be spread open with a piece of stick, sharp-pointed at both ends, placed in one side of the mouth, thus making the opening triangular. Place a pecan nut in the lower corner of the sack, tie one end of a piece of stout twine about it as it lies in the corner, and then tie the other end of the twine to the center of the mouth of the sack opposite the stick. The twine should be short enough to draw the bottom and top of the sack close together, leaving an opening through which the arm may be thrust and the sack slung over the shoulder.

PICKING.—As soon as the greater percentage of the burs have opened, the crop should be gathered. It will not do to wait until all have opened, neither is it advisable to pick the trees over a number of times. Pick them clean at one picking. The burs of those nuts which are fully matured will open; the burs of immature ones may not. The latter should be discarded.

PLATE V.



Pruning of Top-worked tree (one year) showing where cuts should be made (at the lines) to produce a well balanced top. The lower ones are all seedling branches.

1760

The men should climb the trees and pick the nuts by hand, using the bamboo poles only for those which are entirely out of reach. Even this should be done carefully so as not to injure the bearing wood of the trees. Care in picking good nuts by hand will amply repay the grower, because the beating and shaking of the trees will cause a considerable quantity of fruit to be lost, and a few pounds saved will repay all the time and trouble. Of course, in very high trees, there is frequently nothing to do but to shake and thrash the crop off the trees. The plan of covering the ground beneath the trees with a large sheet would work well and assist in reducing losses. As soon as taken from the trees the nuts should be spread out under a shed or in a building to dry. A very convenient plan, and one which will save space, is to provide a sufficient number of trays, three feet by four feet, and three inches deep, with half-inch mesh wire bottoms, and place the nuts in these, two or two and a half inches deep. Racks can be provided around the room in which to place these. In from ten days to two weeks from the time of picking, the nuts should be cured.

GRADING.—The variety should be made the basis of the grade; that is, each variety should be picked, packed and marketed by itself. This besides gives an excellent opportunity to compare the commercial value of different kinds. When a grower has a large number of different kinds of seedling nuts, and a small quantity of each, they may be graded by passing them through screens.

POLISHING.—At the present time practically all of the common market nuts are both polished and colored. Coloring should not be resorted to, and in the case of good varieties of nuts polishing should not be done. In the case of small or mixed lots, however, polishing is useful in making the nuts more uniform. It can be accomplished by putting the nuts with a little dry sand in a barrel fixed so that it can be rotated like a revolving churn and turning until the nuts receive the desired polish. The better nuts, however, should be put on the market just as they come from the trees. The markings, dots and streaks on the outside are their trademark, and should not be interfered with.

PACKAGES.—For shipping small quantities of pecans by express nothing is better than a box. Barrels are best for larger shipments. For mail shipments stout pasteboard, wooden or tin boxes or tin cans make good packages. Frequently shipments are made in sacks, but the sack does not afford sufficient protection to the contents and should not be used. As a rule the box should be made so that a given weight will fill it, but this difficulty may be overcome, to a certain extent, by putting in a pad of paper or excelsior—paper being preferable. Fill the packages on a solid floor, shaking them down well and putting in all they will hold, placing the pad, if one has to be used, in the bottom.

On the outside of the packages before shipping should be placed the name of the grower, the variety, the number of pounds and the shipping directions. Small boxes to be shipped by express for the holiday trade should be wrapped in good quality wrapping paper before shipping.

MARKETING.—The best plan for marketing good pecan nuts is to build up a private trade. As a matter of fact, at the present time but very few of the large, full-meated pecans find their way into the general market. They are either taken by seedsmen or consumed by private customers. In building up a private trade advertising has its place, of course. Advertisements inserted in magazines or papers, particularly in those which are published in the tourist towns of the State, may be found helpful.

The object and aim should be to give each private customer a package, bright, neat, attractive and containing the best quality of nuts. If a certain price per pound is fixed for a given quality, then this should not be varied under any circumstances. Each year the same quality of nuts should be given to each customer. It will not do to give large ones one year and smaller ones the next; this tends to create dissatisfaction. In some of the larger cities there are high-class fruit dealers who handle nothing but fruits, nuts, etc., of the very highest quality. Under some circumstances it might be well to enter into negotiations with such firms.

VARIETIES.

Although the pecan industry is not old, yet a very considerable number of varieties has been brought forward. Not all

PLATE VI



A ten pound box of Van Deman Pecans as packed by Dr. J. B. Curtis.

of these are or have been meritorious, and in fact many varieties are now represented by name alone. Other varieties are comparatively new, and no one can speak authoritatively of what they will do over a wide range of territory. Still other varieties have been propagated by buds or grafts for a number of years with the result that they have been tested fairly well over the country. Some of the varieties so tried have proved satisfactory, others have not. Of the older varieties, Stuart, Van Deman and Frotscher have been found satisfactory in nearly all cases, while Centennial and Rome have proved so unsatisfactory that they have been cut out of the lists of many propagators. It is doubtful whether a more worthless nut has ever been propagated and sold than that much-named variety.—Rome, Columbian, Pride of the Coast, Century, Twentieth Century, etc. For Florida planters the best advice the author can give is plant neither Centennial nor Rome. They either do not bear enough fruit, or that which they do produce is inferior or poorly filled out. Van Deman, Stuart and Frotscher, on the other hand, have generally borne full crops of nuts of good quality.

A satisfactory commercial pecan nut must be prolific, of good size, good quality, must not be spasmodic in its bearing, plump, with a bright, presentable exterior and preferably a light-colored kernel. The nuts should besides yield sixty per cent. or upwards of kernels. All these things in one variety makes a difficult combination to secure. Undue weight must not, however, be given to size, for size and quality are usually antagonistic to each other. In fact, in pecans as in other fruits we must go to the small or medium sized ones for the best quality. No variety of pecan is superior to San Saba in quality, yet it is a small nut. Other varieties which may be regarded as standards of quality are Schley and Curtis. The former is a medium to large nut and medium prolific variety, while Curtis is of medium size, precocious and prolific.

Moneymaker is reported as doing well in Louisiana, and being a medium-sized nut, it is likely to succeed in Florida; but the shell is rather thick. Georgia has proved to be a prolific and a precocious bearer. Nearly all of the varieties given in the following list have been reported upon favorably by different growers.

In planting pecans, no greater mistake than that of planting a large number of varieties can be made. At most the plantings should be confined to four or five varieties. If the grower desires to experiment, and it is a good thing to do, then a tree or two of a number of other varieties should be included, in order to test their merits.

VARIETIES RECOMMENDED.—The following list contains the varieties which are worthy of the attention of Florida planters. Not all of them have been thoroughly tested as yet, and the reason for inserting them here is to urge that this be done—not in large numbers, not in ten-acre blocks, but in lots of two or three trees. In the meantime, until our knowledge of varieties and their adaptations is increased, the safest advice that can be given the Florida planter by the writer is to confine himself to Curtis, Frotcher, Schley, Stuart, Van Deman. This list for plantings in the western part of the State may be supplemented by Bolton, Sweetmeat and Georgia.

BOLTON.—Medium, $1\frac{1}{2}$ -inch x 1-inch; ovate conical; color, dark grayish-brown, marked with purplish-black streaks and splashes from center to apex; base rounded; apex slightly four-angled, blunt, sloping gradually from the center; shell thick 1.9 mm.; partitions thick; cracking quality medium; kernel plump, dark straw-colored; sutures broad, deep; secondary ones, short, rather deep; texture compact, fine-grained; flavor sweet, good; quality very good.

The original Bolton tree is one of six seedlings, obtained by Judge T. M. Puleston in 1885 or 1887 from Mrs. E. Footman of Monticello, Florida, and planted in his house yard at Monticello. The nuts from which the trees were grown came from the Bolton place, six miles south of Monticello. The tree has been badly crowded by two adjoining trees and shaded by the house. Recently, it has been severely cut back to obtain cions. The crop of 1905 was seventy-five pounds of nuts. One hundred pounds is the largest crop borne up to this time.

CURTIS.—Medium, 1.5-8-inch x 7-8; ovate conical, compressed; color, brownish gray, marked throughout with dark specks and a few purplish specks about the apex; base rounded; apex sloping, pointed; shell thin; cracking quality excellent; par-



Varieties of Pecans, all natural size: First row (left to right)—Bolton, Curtis, Dewey, Frotcher, Georgia, Louisiana. Second row (left to right)—
 MoneyMaker, Fabel, Russell, San Saba, Schley, Stuart. Third row (left to right)—Success, Sweetmeat, Van Deman.

20-11-77

titions thin, smooth; kernel straw-colored, marked with dark specks, plump, full with narrow sutures of medium depth; texture compact, firm; flavor sweet, rich, nutty; quality excellent.

The Curtis pecan was grown by Dr. J. B. Curtis, of Orange Heights, from a nut planted March 9, 1886. The first crop was borne in 1893. The original tree has been severely cut back for buds and grafts, but, notwithstanding, has given as much as 80 pounds of a crop in one season. Many of the top-worked trees have given as much, or more, than the parent one.

DEWEY.—Medium to large, 1 7-8-inch x 3-4-inch; ovate pointed; color dull gray and marked with splashes of purplish-brown; base rounded; apex sharp; shell brittle and thin; cracking quality very good; partitions thin; kernel full, plump, smooth, bright light straw-colored with narrow sutures of medium depth; texture firm and solid; flavor sweet, rich, good; quality very good.

The original tree stands on the Morris farm, seven miles south of Monticello, Jefferson County, Florida. The tree is now about twenty years old, and is badly located. It stands by the roadside, in the garden yard. It has received no cultivation, and the road-bed has been cut down five or six feet, leaving the tree standing on a bank. In view of this fact, it is difficult to speak definitely of its prolificness.

FROTSCHER.—(Syn.: Frotscher's Eggshell, Eggshell, Olivier, Majestic.) Large 1 5-8-inch x 1 7-8-inch; cylindrical ovate; color bright yellowish-brown, with a few black splashes about the apex; base broad, rounded; apex blunt-pointed, four-angled; shell slightly ridged, smooth, thin; partitions thin; cracking quality excellent; kernel brownish-yellow, dark veined, frequently slack at one end; sutures of medium depth, rather narrow; secondary sutures well marked; texture dry, rather coarse; flavor good; quality fair to medium.

The above description was made from specimens received from J. Steckler Seed Company, New Orleans. The original tree stands in the garden of H. J. Pharr, Olivier, Louisiana. The place was formerly owned by Oscar Olivier. The variety was first propagated by Mr. William Nelson, and catalogued as Frotscher's Eggshell by Richard Frotscher in 1885.

The variety is precocious, productive, and succeeds over a wide range of country.

GEORGIA (Syn. Georgia Giant).—Size large, 1 1-2-inch x 1 1-8-inch x 1-inch; rounded ovate; color brownish-gray, marked with splashes and dots of dark brown covering a good part of the surface; base rounded; apex tapering, blunt; shell brittle, medium in thickness; cracking quality medium; partitions thick, corky, red; kernel bright, reddish-brown, plump, full, compact, fine-grained; flavor sweet; quality very good.

The Georgia pecan was raised by Mr. G. M. Bacon, Dewitt, Ga., from a nut of uncertain origin, planted in 1885. The one-year-old seedling was transplanted in the year 1886. The first crop, borne in 1891, was 32 nuts. The tree has been severely cut for buds and grafts, but in 1901 produced 4 1-2 bushels, or about 250 pounds of nuts. Young trees of this variety have proven exceedingly precocious.

LOUISIANA.—Size medium, 1 7-8-inch x 7-8-inch x 3-4-inch; oblong cylindrical; color grayish-brown, marked with splashes of purplish black toward the apex; base rounded, sloping; apex sloping, pointed; shell rather thick; partitions of medium thickness; cracking quality very good; kernel full, plump, dark yellow; sutures broad, shallow; texture firm, compact; flavor sweet, good; quality very good.

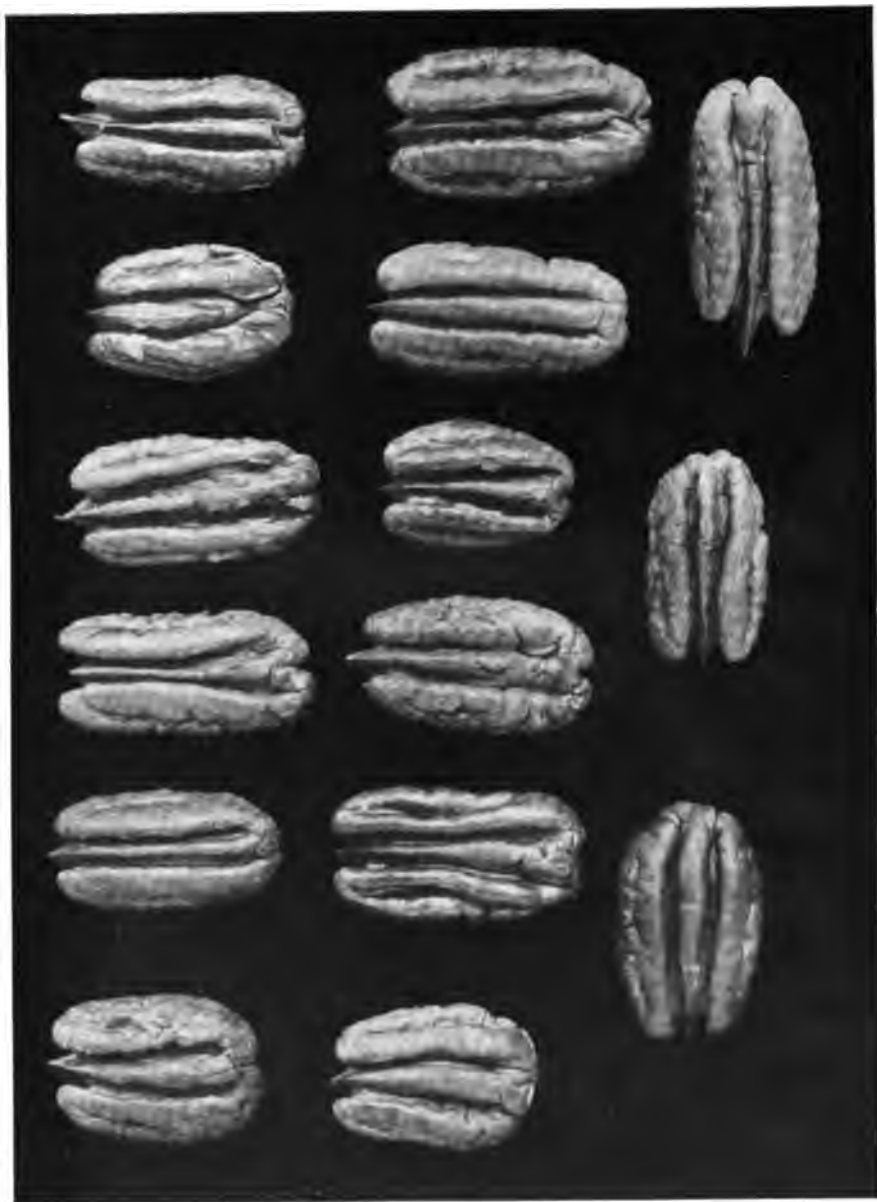
Described from specimens received from Summit Nurseries, Monticello, Florida.

MONEYMAKER.—Size medium, 1 5-16-inch x 1-inch; ovate oblong; color light yellowish-brown with a few purplish-brown marks about the apex; base rounded; apex abruptly rounded, slightly wedged, small nipple; shell of medium thickness; partitions medium thick, corky; cracking quality very good; kernel full, plump, broadly oval; sutures straight, broad, shallow, secondary ones small; texture firm, solid; flavor sweet, good; quality very good.

Described from specimens received from Professor F. H. Burnette, Baton Rouge, Louisiana. This pecan was originated and introduced by Mr. S. H. James, Mound, Louisiana. The quality is very good, and the variety is precocious, prolific and hardy.

PABST.—Size large, 1 5-8-inches x 7-8-inch; oblong cylindrical; color dull gray, marked with broad splashes of purplish

PLATE VIII.



Pecan Kernels, all Natural Size: First row (left to right)—Bolton, Curtis, Dewey, Frotscher, Georgia, Louisiana. Second row (left to right)—Money-maker, Fabst, Russell, San Saba, Schley, Stewart. Third row (left to right)—Success, Sweetmeat, Van Deman.

black; base rounded; apex blunt, four-angled, grooved; shell of medium thickness; partitions rather thick; cracking quality fair; kernel plump, large, thick, with broad, shallow sutures, secondary sutures short, shallow, bright yellow in color; texture fine; flavor good; quality very good.

Described from specimens received from Mr. William A. Taylor, United States Department of Agriculture. The original tree, according to Mr. Taylor, is one of a number of seedlings on grounds of the late William B. Schmidt at Ocean Springs, Mississippi. The original tree is now about thirty years old. Quite productive, and recommended for planting by those who have tested it.

RUSSELL.—Size medium to large, 1 5-8-inches x 7-8-inch; form ovate, slightly compressed; color grayish-brown with small specks and splashes of purplish black; base rounded, bluntly pointed; apex abruptly sloping; shell very thin, brittle; partitions very thin; cracking quality excellent; kernel usually plump, though sometimes shrunk at the base, sutures broad and shallow, dark straw-colored; texture fairly compact; flavor dry, sweet; quality good.

Described from specimens received from Mr. Charles E. Pabst, Ocean Springs, Mississippi. The original tree stands in the yard of Mrs. H. F. Russell, Ocean Springs, Mississippi. The tree is one of a lot of seedlings raised by the late Colonel W. R. Stuart, about 1875. The tree was planted where it now stands by Peter Madsen. It was named by Mr. Charles E. Pabst, and propagated by him in 1894.

SAN SABA.—Size small, 1 3-8-inches x 7-8-inch; ovate, slightly compressed towards the apex; color, bright reddish-yellow, marked with purplish-brown splashes, extending from about the middle to the apex; shell very thin and brittle; partitions thin; cracking quality excellent; kernel very plump, smooth, deeply and broadly grooved, bright straw-colored, oval in outline; texture solid, fine-grained; flavor rich, sweet, delicate; quality excellent.

The San Saba may be regarded as a standard of quality among pecans as the Seckel is among pears. Described from specimens received from E. E. Risien, San Saba, Texas. The variety was introduced by Mr. Risien, about 1893. The original

tree stands on the San Saba River, near its intersection with the Colorado River, in Texas.

SCHLEY.—Size large, 1 7-8-inches x 7-8-inch x 3-8-inch; oblong, oval flattened; color, light reddish brown, marked with small specks about the base and small splashes of purplish-brown about the apex; base rounded, abruptly short nipped; apex abrupt, flattened on two sides and rather sharp-pointed; shell brittle, dense, thin; cracking quality excellent, shell breaking easily and readily separating from kernel; kernel very full and plump, smooth with shallow sutures and almost entirely free from wrinkles, very light yellow in color; texture very firm; flavor rich, sweet.

Obtained from H. K. Miller, Monticello, Florida. Said by some to be only medium prolific, but the exceedingly high quality and well-filled kernels leave little to be desired in the nut itself. It ripens early in the season, middle of September to first of October. It begins growth late in spring, but not so late as Stuart.

STUART (Syn. Castanera).—Size large to very large, 1 7-8-inches x 1-inch; ovate cylindrical; color grayish-brown, splashed and dotted with purplish-black; base rounded, tipped; apex blunt, abrupt, somewhat four-angled; shell medium in thickness, 1.1 mm.; partitions thin; cracking quality very good; kernel plump, full, bright straw colored; sutures moderately broad and deep, secondary sutures not well defined; texture solid, fine-grained; flavor rich, sweet; quality very good.

Described from specimens received from the Stuart Pecan Company, Ocean Springs, Mississippi. This variety has been tested, found to succeed and to be prolific over a wide range of country. The original tree,* grown from a nut planted by John R. Sassabee, about 1874, stood in the garden now owned by Captain E. Castonera, Pascagoula, Mississippi. It was blown down in October, 1893, but a new shoot, now in bearing, has sprung up from the roots. First propagated in 1886 by Mr. A. G. Delmas, Scranton, Mississippi. It does not begin growth until quite late in spring, a desirable feature for some sections.

Success.—Size large, 1 9-16-inches x 1-inch; oblong, ovate.

* Taylor, William A. (Yearbook), 1904.

tapering from near base to apex; color, light yellowish-brown, strongly marked with purplish-brown splashes about the apex; base flattened, roundish; apex blunt, four-angled; shell thin, .93 mm.; cracking quality very good; partitions thin; kernel large, full, plump, filling the shell; light yellow in color, sutures broad, of medium depth, inner surface wrinkled, oval in outline; texture firm, solid, compact; flavor sweet, rich; quality very good.

The original tree was found "growing in a crowded row of seedlings planted at Ocean Springs by the late W. B. Schmidt about ten years previously. The original Success tree first attracted attention in the fall of 1901." Described from specimens received from Mr. Theo. Bechtel, Ocean Springs, Mississippi. This is a very desirable nut, and if as prolific as the variety is good, it will indeed prove a valuable acquisition.

SWEETMEAT.—Size medium, 1 1-4-inches x 7-8-inch; oblong; color, bright grayish brown, marked with small streaks of purplish brown about the apex; base rounded; apex abruptly blunt; shell thin, .8 mm.; partitions of medium thickness, corky; cracking quality good; kernel plump, full, somewhat wrinkled, light yellow, sutures broad, shallow; texture fine-grained, compact; flavor sweet; quality good.

Originated from seed obtained in New Orleans by Mr. D. L. Pierson, Monticello, Florida. Planted out in its present position when one year old, in 1892 or 1893. It bore its first crop five years after planting. The tree stands on the property of the Summit Nurseries, Monticello, Florida. It is a very prolific variety, in all probability a seedling of Frotcher. Described from specimens taken from the original tree.

VAN DEMAN.—Large to very large, 2 1-8-inches x 7-8-inch; oblong cylindrical; color, reddish-brown, with splashes and streaks of purplish-brown; base sloping, blunt-pointed; apex tapering, sharp-pointed; shell of medium thickness; cracking quality fair; partitions thick; kernel light yellow, with a few dark specks, sutures rather deeply and narrowly grooved, with secondary sutures forming a mere line; kernel fine-grained and compact, sometimes slack at the end; flavor sweet and delicate; quality very good.

Specimens for description obtained of Dr. J. B. Curtis, Orange Heights, Florida. Quite widely tested and recommended for planting.

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2.	J. Kost.	General	May and June, 1888.
4.	Jas. P. DePass.	General	January, 1889.
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12.	Jas. P. DePass.	General	January 1st, 1891.
13.	Jas. P. DePass.	General	April, 1891.
16.	Jas. P. DePass.	General Farm Crops	January 1, 1892.
17.	Jas. P. DePass.	General	April, 1892.
19.	Jas. P. DePass.	Tobacco	October, 1892.
22.	A. A. Persons.	Fertilizers	November, 1893.
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28.	A. W. Bitting.	Liver Fluke — Southern Cattle Fever	December, 1894.
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36.	A. L. Quaintance.	Insects Injurious to Grain.	October, 1896.
37.	O. Clute, W. A. Marsh.	Pineapple	November, 1896.
38.	F. B. Moodie.	Tobacco in Florida.	January, 1897.
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BULLETIN No. 85.

MARCH, 1906.

• FLORIDA •
AGRICULTURAL EXPERIMENT STATION.

Second Report on Pecan Culture.



A Basket of Randall Pecans.

By H. HAROLD HUME.

(Formerly Horticulturist of the Florida Experiment Station; now Horticulturist of the North Carolina Department of Agriculture and the North Carolina Experiment Station.)

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†Superintendent Farmers' Institutes.

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